RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.

Published Every Friday by The Railroad Gazette at 83 Fulton Street, New York
Branch Offices at 375 Old Colony Building, Chicago, and Queen Anne's Chambers, Westminster London

EDITORIAL ANNOUNCEMENTS

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Transport and Railroad Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Vol. XXXVIII., No. 23. Friday, June 9, 1905.

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The Elkins committee is reported as being disinclined to report to Congress a bill to carry out President Roosevelt's wishes in regard to rate regulation; but on some other branches of the relations between the Government and the railroads—outside of the specific inquiries which the Senate entrusted to this committee—the members seem to be actively interested. One of these points is a suggestion made by President James J. Hill, of the Great Northern, to enact Federal laws prescribing criminal punishment for trainmen who, by violating the rules, bring on accidents. Mr. Hill is said to believe that the penalties prescribed by the state laws are insufficient, and that if derelictions of this kind are tried in the Federal courts accidents will be more surely prevented. All experience indicates the contrary. The chief reason that negligent enginemen, conductors and signalmen are not punished under the laws of the several states is that juries so often find that other persons besides those arrested and tried, are in part responsible for the accidents. It is the sympathies of the jurymen, and the hindrances encountered by the district attorneys, that explain the infrequency of punishments, rather than the lack of laws. It is true that in most cases one of the district attorney's hindrances is his own disinclination to take up and prosecute unpleasant or unprofitable suits, but this is only one. It is true also that prosecuting officers often find it difficult to bring all guilty persons to trial for the reason that the statutes do not exactly fit the offence; but with perfectly worded statutes there would still be the greater difficulty of the jurymen's sympathy, for even if all of the collaterally responsible persons were brought into court, the perplexities of unequal punishment would still exist. For example, when a trainman makes a mistake because he is overworked, the defense always tries to blame some one "higher up" for requiring overwork. Hardly a collision occurs but two, and often three, persons are found to have co-operated in causing it. Juries do not have the courage to inflict such all-around punishment. And, finally, it is hard for either jury or judge to imprison a man for a mistake which it is plain was mostly, if not wholly, an error of judgment. Cases due to what would be called recklessness are not unknown, of course; but in practically 95 per cent. of the serious cases in the accident record it is plain that an unauthorized habit, or slovenly instruction or some other curable defect, is the real cause; and the only remedy or preventive (aside from the needed change in system, from time interval to space interval) is patient, vigorous and continuous training of all of the responsible men in the service. As long as men's errors are such as to directly and palpably endanger their own lives, it is ridiculous to think of curing the evil by fines or imprisonment.

The proposition to consolidate the Master Car Builders' and Master Mechanics' Associations into one organization, which was suggested by President Brazier last year in his address, is pretty sure to be revived again at the coming conventions with renewed interest, although it hardly seems probable that any definite action on the part of either association will be taken just yet. There will be opposition to such a consolidation by many of the older members who, as a matter of sentiment, would regret seeing either body lose any of its characteristic identity in a merged organization. Both associations have enviable records for the past 40 years, and each has accomplished great and good work which will always stand as a monument to the perseverance, earnestness and foresight of the men who have been identified with them. We respect and admire the sentimental regard for the old order of things which prompts opposition to any change, but we believe with Mr. Brazier that the best interests of both organizations demand in the near future a consolidation into one. The old school of the car builder and the master mechanic is passing, and with it the old associations must also change in their traditions and scope of work. The extended introduction of electric traction will require knowledge of electrical machinery in place of steam engines and boilers; the increasing use of steel in car construction has transformed the car builder from a worker in wood to a worker in metal.

In the organization of railroads the car and locomotive departments are being more and more combined under one head, and every year the proportion of members of one association who belong to the other grows larger. Last year 45 per cent. of the members of the Master Car Builders' Association were also members of the Master Mechanics' Association, and among those who belong to both organizations are the representatives of the largest and most important railroads. These men would welcome a consolidation of the two associations, for no matter how closely the two are affiliated there cannot be the same unity of action as with one larger body. Those who attend the meetings of both the Master Car Builders' and the Master Mechanics' associations have complained that they lose interest in the later meetings. They have a full week of attendance, and it is not to be wondered at that they tire of listening to discussions toward the end. If they could attend one convention with fewer meetings more interest would be elicited, a better attendance would be had and most of the visitors would undoubtedly be better satisfied. The great trouble with the meetings of nearly all such organizations is that too ambitious a program is prepared, so that many of the subjects must needs be carried over or dismissed in a hurried and perfunctory manner. Provided a combined organization of the two associations did not attempt to do too much in too short a time, we are convinced that it would be wise to make such an amalgamation.

Many of the members of the Master Mechanics' and Master Car Builders' Associations who attend the conventions at Manhat-

tan Beach this year will be interested in the various electrification projects in and around New York. The New York Central and the Pennsylvania have not yet advanced their work beyond the preliminary experimental and constructive stage, but the present installment of the Long Island's electrification project is now almost completed. A number of the steel cars which are to be run in suburban service have been received, and are at the company's shops in Jamaica, and the power house, third-rail and sub-station equipment is far enough advanced to give a clear idea of the character and magnitude of the undertaking. A trip over the Long Island's electrified line would be well worth while for any of those who, in the near future, may be called upon to work out similar problems.

SUPERHEATED STEAM IN LOCOMOTIVE SERVICE.

The test of a superheater locomotive by the Chicago & North-Western, printed elsewhere in this issue, is the first test of this kind in American practice to be so recorded. The results are instructive, and will doubtless be received and studied with more than ordinary interest. The charts recording in graphic form the principal conditions of the run enable the relations of various events to be readily traced and compared. The comparison for efficiency of the locomotives is based on the foot-pounds of work delivered per pound of coal and per pound of water, the superheater locomotive showing an advantage of 7 per cent. and 9.2 per cent., respectively. In considering these figures the low degree of superheat in the steam chest should be taken into account, the maximum being only about 30 deg. and the average much less. But even had the average been 30 deg. the theoretical advantage would not be very great. The economy resulting from the use of superheated steam is roughly proportional to the amount of superheat for any given set of conditions, the increase in economy growing greater in proportion, however, as the temperature rises. Therefore, had it been possible to obtain a steam chest temperature approximating that of the superheater, an advantage in work delivered per pound of coal of 15 to 20 per cent. might reasonably have been expected of the superheater engine. It would thus appear that if the full possibilities in the way of economies from such devices are to be realized in practice, some means would need to be found by which most if not all of the heat would be retained in the steam until it reaches the cylinders.

A comparison of the steam-chest temperature lines for the freight and passenger superheater engines shows the latter to average very much better than the former, particularly at the earlier part of the freight run. These curves exhibit the difference in effect on the superheater of working the engine at short and long cut-offs. In the latter case the large volumes of steam demanded, passing rapidly through the superheater, have insufficient time in which to absorb all of the additional heat available. The obvious conclusion would seem to be that on locomotives, superheaters will give the best results in passenger service where the engines work pretty uniformly at economical cut-offs, and that the heavier and more severe the service in which the locomotive is engaged, the less benefit will be derived from a superheater.

Considerably higher superheater temperatures than were realized in this test have been obtained in locomotive service. A New York Central locomotive equipped with the same type of superheater gave an average temperature of 517 deg. from a boiler pressure of 200 lbs., or a superheating of 130 deg.; and German locomotives with Schmidt superheaters have attained 575 deg. from a boiler pressure of 180 lbs., or a superheating of 195 deg. A year or more ago it was reported that service tests on the Canadian Pacific with a Schmidt superheater locomotive had shown savings (on a ton-mile basis) of 3 per cent. in fuel as compared with a similar non-superheater locomotive. Assuming a coal consumption of 250 lbs. per 1,000 ton-miles and a performance per engine-month of 1,000,000 ton-miles, with coal at $2 a ton, the yearly saving in fuel would amount to nearly $1,000 an engine. The saving at 7 per cent.—the North-Western figure—would be $210.

THE MECHANICAL STOKER.

Railroad men and those interested in railroad work have for some time been asking themselves and each other as to the probable upper limit of size in locomotive construction. Matters have gone forward with such leaps and bounds during the past twenty-five years that one has been obliged to be on the alert in order to keep in touch with the advancement that has been made. Locomotives with from three to three and a half times the heating surface of the ordinary practice of the early eighties are now so common as to attract hardly a passing notice, and no one feels sure that the end has come.

In all of this growth we have heard much of the strength of material, the efficiency of heating surface, the proper loading of bridges and track, and the economy of high steam pressures and heavy loads, but hardly a word about the man.

Unfortunately, he remains the same as in the days of small engines, while the only consideration that he has received is in the limitation of the length of the firebox. Practical working with extra long fireboxes showed them to be impossible when considered from the physical standpoint of the man; firemen were found to be incapable of throwing coal to the front of such a box with any certainty of placing it where it was needed. So there has been a limit placed upon the length of this part, though in other respects the modern locomotive seems to have been developed regardless of the man who is to feed its furnace.

The fatigue of those who fire large engines over a long division and the complaints arising from this over-exertion have been so pronounced that the subject of placing three men on these engines has not only been seriously considered by railroad men, but has been aggressively demanded by the labor organizations. The matter has already been brought to the attention of the legislatures of Indiana and Ohio, with the view of making it a legal requirement that two firemen be used on such machines. The railroads object to this for the reasons that the second man will increase the expense and probably decrease the efficiency of the whole crew. The argument of the men is, however, a potent one, that the work demanded is more than the average fireman can perform.

That there is much of truth in this there can be no doubt. Just what the railroad companies lose by this over-exertion of the men no one knows, though it would be interesting to determine the difference in the total efficiency of the locomotive between the first ten and the last ten miles of a hundred and fifty-mile run, attributable to the loss of efficiency or fatigue of the man. At any rate, the railroads are being pressed to put a larger crew on the big engines. Their saving defence will be that more than two men are not needed, and to prove this latter point the assistance of some form of a mechanical stoker will have to be invoked. For many years the air has been full of talk and speculation about the availability of such a device, and one or two forms have been tried, with more or less success, in an experimental way, but no road as yet has either adopted one or made an application on a large scale.

The prospects are, however, that the preliminary work along these lines is emerging from the tentative and experimental and entering upon the practical stage of development, when the mechanical stoker may be expected to work with all the reliability of the injector, or the air brake, or any of the other attachments that, in their day, have passed through the disheartening period of experimental work. In what the stoker is now doing, it has been demonstrated that it is capable of distributing the coal evenly over the surface of a large firebox; of maintaining steam pressure under a wide range of requirements, and of picking up a pressure that has been lost through inattention on the part of the fireman. That it is successful on these points there is ample proof. It might win out on all of these counts, however, and still fall far short of being a commercial or mechanical success, if it added to the labors of the fireman, or wasted coal. As to the latter point, there are no data available. The impression prevails among those who are using stokers, that the coal consumption remains about the same as with average hand firing. Smoke is freely and continuously discharged from the stack, and there is evidently room for improvement here. But it should not be expected that a device which has not yet reached the point of official adoption should excel all previous attempts to do the work for which it is intended, at every point. The problem attacked, up to the present, has been to put coal into the firebox of a large locomotive while it is at work, in such quantities and in such a way that steam will be continuously maintained at the proper pressure to enable the engine to do efficient and satisfactory work. With this accomplished, any slight difference in coal consumption, even though it might be in favor of hand firing, should not be allowed to militate for a moment against the use of the stoker. The matter of coal saving and smoke prevention can be taken up later, and will probably have to be worked out in detail to meet the requirements of each individual case, according to the quality of coal that is used. It is not at all probable that the same arrangements would answer equally well for the

high-grade Pocahontas and the inferior coals of Illinois and Iowa.

As to the first point, the labor of manipulation, the question can be easily settled. One strong point is that the men like the stoker, and this would certainly not be the case if it added to their labors. If this fails to convince, a ride on an engine and a consideration of the fact that the fireman has no door to open; that he can stand well back from the boiler head in doing his work; that he is not exposed to the direct radiation of the fire at any time except at the rare intervals of raking the surface; that he has merely to shovel coal from the floor of the tender to a hopper with no care or attention as to where the coal falls, so long as it does not drop outside the edge of the stoker, and that this can be done *en bloc*, with intervals of rest between—all of these things will convince the observer that the work is easier. And it is easier to such an extent that a man can now fire one of these engines with far less exertion than he could formerly handle one of much smaller dimensions. It is possible, too, that even this work will be minimized by the addition of a conveyor that will take the coal from the tender and put it in the hopper of the stoker, though this is still a promise of the future.

In the minds of some, the introduction of the mechanical stoker means the lowering of the requisite skill of the fireman and his replacement by the common laborer. This is far from being warranted by the facts. Like every other improvement in applied mechanics, an increased complexity demands an increased skill on the part of the operator. This holds especially true in the case in hand. The fireman cannot blindly dump unlimited amounts of coal into a hopper and expect an inanimate machine to so regulate its discharge as to do the proper thing at the proper time under all of the varying demands for steam that may be made by the engines. He must, more than ever, be conversant with the laws of combustion and the methods by which the best results are obtained. He must use his brains in the interim between the fillings of the hopper, and he will find that his time is fully occupied. The mechanical stoker will not make the position of fireman on a heavy locomotive a sinecure, it will simply relieve his muscles to demand more of his head.

With this promise of relief at hand, there is no probability that the shadow of the big locomotive will ever be less or its economy impaired by a failure to work it to its maximum efficiency. That all these happy results will be accomplished in the twinkling of an eye is not to be expected, but there is strong tangible evidence that they are within the possibilities and probabilities of the near future, and that we may expect to see the mechanical stoker as firmly established for certain classes of locomotive work as it is in stationary plants of great magnitude.

Grand Trunk.

For the half year ended December 31, gross receipts of this company were $15,210,-896; working expenses, $10,716,742; net earnings, $4,494,154 and net income, $5,010,880, this last figure being an increase of $86,461 over 1903. Receipts from passengers were $4,818,612, an increase of $273,297 over 1903 and from freight and live stock, $9,263,864, a decrease of $319,836 from 1903. There was a decrease during the half year of 77,536,244 tons and in the number of tons carried one mile, and of 10½ cents in the average rate per ton. There was an increase of $113,520 in maintenance of way, and a decrease of $188,-398 in conducting transportation expenses. The total charges to capital account for the half year were $1,164,900, of which $316,420 was for double-tracking, 47.29 miles of which were completed during the six months. No additions to capital account on account of new equipment were made during the half year. There were, however, 25 compound mogul freight locomotives, three switching locomotives and 150 refrigerator cars built in the company's shops, and five passenger locomotives, two dining cars, four parlor cafe cars, six first class cars, three baggage and second class cars, and ten baggage cars bought. Twenty-two new stations were built during the same period. In the equipment account, there is an apparent decrease in the total number of freight cars compared with the preceding year. Owing, however, to the larger size of recent additions, the carrying capacity of the cars in service has been increased by 129,633 tons, which is equal to an increase of 5,064 cars of the present average capacity. The statement of securities owned shows that the Grand Trunk Railway Company of Canada owns $2,185,100 of the $3,000,000 total capital stock of the Central Vermont and $1,583,300 of the 4 per cent. first-mortgage bonds of that company. The company also owns $2,030,000 capital stock of the Grand Trunk Pacific and $1,500,000 stock of the Canadian Express Company.

The gross receipts of the Grand Trunk Western for the half year were $2,538,281, a decrease of $283,843, and working expenses were $2,158,681, a decrease of $264,374 over the preceding year. This leaves a net profit of $379,600 against $399,069 in 1903. As the net revenue charges for the half year were $402,135, there was a net revenue debt after charges of $22,536. This compares with a net credit of $10,648 in 1903.

Beginning at Long Island Sound a few miles eastward of New York City the Connecticut state line stretches northward about 75 miles to the southwestern corner of Massachusetts. The accidents of early colonial settlement and the *dixits* of royal charter on the one hand, and the growth of our eastern commonwealths on the other, happen to have placed this line right between two great hives of population focussed on the southwest at New York, Philadelphia and the cities below and on the northeast at Boston, Providence and the bustling industrial municipalities of New England. It may seem a bold statement when one asserts that the Connecticut legislature has just made this invisible line a barrier which no steam railroad or long distance electric railway can ever pass hereafter without the consent of the New York, New Haven & Hartford Railroad Company, but the fact is certified. It has come to pass by the expedient of repealing that part of the general railroad law of the state which, under certain conditions, has allowed new roads to be built without applying to the state legislature; so that now any parallel project must run the gauntlet of the Connecticut Senate, which hardly in the memory of living man has been counter to the New Haven Company's wish. The story of a measure, which may hereafter have great results on railroad combinations at the east, has its satirical, not to say humorous, vein. When President Mellen took the Ontario & Western it will be recalled that the New York Central made a rapid survey for a new line across Connecticut to Springfield, Mass. We characterized it at the time as not much more than a menacing gesture intended to make the New Haven President relax his hold on his new line to the coal fields. It was probably not much more serious. But the resourceful Mr. Mellen saw his opportunity. He convened his "open air lobby" of the whole Connecticut legislature, entranced it with his tale of the plan of "punishing" his corporation for giving Connecticut cheaper coal, ran his bill by a big majority across the danger line of the lower house and converted the mere feint of the New York Central into his own big stick. The irony of railroad annals in Connecticut becomes the more picturesque when it is remembered that the lower house of Connecticut's General Assembly forced President Hall to withdraw a similar bill two years ago, and the state which has been for many years shouting "monopoly" now rivets it by law.

The New York Central announced last week the shortening by one hour of the time of the Twentieth Century Limited eastbound, and the announcement was followed within a day or two, by one from the Pennsylvania saying that an 18-hour train would be run each way, daily, between New York and Chicago, beginning June 11. As we go to press, the New York Central has met this with the announcement that the time of the Twentieth Century Limited will be cut to 18 hours in each direction. The New York Central trains now run through in 20 hours each way. This makes the "apparent" time 19 hours westward and 21 hours eastward, and the 18-hour train will have to run its distance westbound in 17 hours elapsed time, at an average speed, including stops, of 56.7 miles an hour (964 miles). The train will hereafter leave New York at 3.30 o'clock in the afternoon, arriving in Chicago at 9.30 the following morning. Returning, it will leave Chicago at 2.30 p. m., reaching New York at 8.30 the following morning; thus lengthening from 2 hrs. 45 mins. to 5 hours the time available in Chicago for a passenger from New York by this train who wishes to have as much of the day there as possible and to be in New York before business hours the following morning. The 18-hour schedule means simply the extension of the time of the Empire State express through from Buffalo to Chicago. The run on the Lake Shore has heretofore been considerably slower than the run on the Central. At the same time, the Lake Shore Limited will be quickened by one hour and will make the run from Chicago to New York in 23 hours instead of 24, while the Southwestern Limited will have its schedule time from New York to St. Louis and Cincinnati reduced by 1 hr. and 4 min. The Pennsylvania trains, if they do not run to Broad Street, Philadelphia, will have to travel about 50 miles an hour, the distance by this route being about 907 miles. The newspaper accounts give the distance as 897 miles, measuring it by way of the Trenton cut-off, but no officer of the road has said that the trains will be run by that route. Cutting out the ferry between New York and Jersey City (one mile) and deducting 13 minutes from the schedule on this account, and deducting a considerable distance in Chicago that has to be traversed at reduced speed, leaves about 900 miles to be covered in about 17½ hours, or at the rate of nearly 52 miles an hour. A press despatch from Chicago says that a special train has this week been run through in 17 hours.

It is fair to say that friction draft gear is not receiving as much attention as it deserves. As we said last January in an editorial on this subject, the principle of the application of friction in the moving parts

of draft gear to assist in absorbing the shock is a logical, simple and correct one, and it is hard to see why the railroads have not adopted the friction gear to a larger extent than they have. Probably it is largely due to the friction draft gear makers themselves, for as yet they have not given conclusive enough evidence to the more conservative railroad men of the ability of friction gear to reduce the ever increasing repairs to draft rigging and underframes. Friction draft gear makers must show that the friction gear does reduce the cost of repairs, and that it reduces them enough to pay for the extra cost of its application. Many tests have, of course, been made, including a most severe test of a 50-car train. This was spectacular, but not conclusive. Many laboratory tests, both drop and static, have also been made. The results of these in every case were in favor of friction gear. A test recently given on a model drop testing machine is described elsewhere in this issue. Probably the most tangible results yet obtained in a laboratory test were produced by this model, and they showed as conclusively as static tests that friction does absorb energy. As we said before, the friction draft gear makers have now to prove conclusively that the friction is the superior gear. There is no doubt that interesting, valuable and convincing data would be added to the draft gear question if some one, either maker or user, would make a series of "collision" tests, as suggested in the *Railroad Gazette* of Jan. 13, 1905.

NEW PUBLICATIONS.

A Treatise on Concrete, Plain and Reinforced. By Frederick W. Taylor, M.E., and Sanford E. Thompson, S.B., Assoc. M. Am. Soc. C. E.; with chapters by R. Feret, William B. Fuller and Spencer B. Newberry. New York: John Wiley & Sons, 1905. Octavo, cloth, XVIII + 585 pages. One print, one folding plate, 175 figures. $5.00.

This treatise begins with definitions and carefully prepared elementary information. There are specimen contracts and specifications for Portland cement, concrete, and for the steel to be used in reinforced concrete. The class of work in which Portland and natural cements should be used is discussed, as well as the economy of using Portland cement where natural cement could be used, depending upon the relative cost of the cements, sand and stone. The chemistry of hydraulic cement is clearly explained. The chapter on standard cement tests is particularly good. Instead of giving a lot of rules mostly from European sources, the Progress Report of the Special Committee on Uniform Tests of Cement of the American Society of Civil Engineers is reprinted, with additional notes. Cuts showing the apparatus used are given; also a diagram showing the difference of the time of setting as indicated by the Vicat and Gillmore needles when different percentages of water are used. Several pages of sketches of test pots are given. Fifty-two pages are devoted to a discussion of the proportioning of concrete, eight pages of which are tables of quantities of materials for concrete and mortar.

The strength of plain concrete is discussed, and the authors give a formula which aims to give the comparative strength of concretes of different proportions. The discussion of concrete and its constituents comprises one-half of the volume, and the balance is devoted to the practical uses of concrete both plain and reinforced. Fourteen examples of beam and slab design and the solution of each are given. Methods of mixing concrete are illustrated at length, and 52 pages are devoted to a description of concrete work in foundations and piers, dams and retaining walls, arches, tunnels, conduits, reservoirs and tanks. In compiling this work the authors have quoted freely from recognized authorities and entire chapters have been contributed by specialists, making a very useful volume.

Electric Railways.—By Sidney W. Ashe and J. D. Kelley. D. Van Nostrand & Co., New York. Price $2.50.

This book is intended for use as a text book in "technical institutions as well as a general engineering reference book for those interested in railway problems." With this object in view it necessarily contains much that must be considered as elementary though indispensable from the standpoint of the text book. It opens with definitions of items that must be taken into consideration in train testing and operation, followed by an analysis of train performance. In this the calculations of acceleration, deceleration, the effect of grades, curves, train resistance and electric current are treated. Here, too, there is brought out very graphically the variations in the several formula for train resistances. On comparing the Davis and *Engineering News* formula for single car operation it appears that at 80 miles an hour the resistance according to the former is 70 lbs. per ton; while, according to the latter, it is but 22 lbs., a discrepancy that is irreconcilable though explicable on the ground that the Davis formula takes the number of units into consideration and the other does not; a condition showing that possibly we still have a thing or two to learn about train resistances.

Direct and alternating current motors with the various types of control are thoroughly and systematically treated. These chapters are the longest and most important in the book. Car bodies and trucks are also handled in a general way to give the student a fair idea of the construction and requirements of the rolling stock of electric railways.

As one of the authors has done a good deal of original work in brake testing and the analysis of train work, it is quite natural that this should appear in the chapter on brakes. The various types of brakes for electric cars are described, to which is added an analysis of the requirements of the suitable brake and of the forces operating upon the car.

The final chapter on electrical measurements gives full data regarding the instruments needed for testing on electric railway work. The book as a whole is necessarily somewhat condensed, but this has not been done at the expense of clearness. The higher mathematics appear occasionally, but there has been an attempt to avoid this method of demonstration wherever it has been possible, and thus put the book on a practical working basis. In this the railway experience of the authors has stood them in good stead, and they have succeeded in producing an exceedingly valuable work for the purposes for which it was intended.

TRADE CATALOGUES.

Valves.—The Golden-Anderson Valve Specialty Co., Pittsburg, Pa., issues pamphlet No. 2 describing its product. This includes various designs of valves, including combination, cushioned, non-return, pressure reducing, automatic and counterbalanced valves, automatic valve and water column, float valves, and automatic tilting steam traps. The various designs are illustrated, sectional views showing their construction. They are fully described. Several styles of water columns are described and illustrated and details of the valves shown. Other features include Anderson altitude valves, automatic water-controlling valve for pumping stations, check valves, and chronometer and regulating valves for steam and water.

Pneumatic Tools and Appliances.—Thor Souvenir, 1905, illustrates and describes the pneumatic tools and appliances of the Aurora Automatic Machinery Co., Aurora, Ill. The list includes piston air drills, pneumatic hammers, air turbines, flue rollers, holders-on, etc. Various sizes of air drills are shown, including several sectional views, and the principal characteristics of each are enumerated. Styles of pneumatic hammers are likewise presented, and the other pneumatic appliances already mentioned. The book is a convenient pocket size, is printed in two colors and contains 42 pages.

Roofing.—The Standard Paint Co., New York, is distributing its May issue of "The Exchange." This issue is devoted almost entirely to describing the various uses of Ruberoid roofing. It also describes a new roofing which is being placed on the market by the above company. The latter is known as "Ruberoid red roofing." It is a permanent red and does not require pointing.

Chain Blocks, Locks and Hardware.—The Yale & Towne Mfg. Co., New York, sends two booklets, one of which deals with locks, builders hardware and door checks for railroad use, and the other is devoted to a full line of the Yale & Towne chain blocks and portable electric hoists. An excellent map of New York City is included in the last mentioned pamphlet.

Air Compressors.—The Chicago Pneumatic Tool Co., Chicago, is distributing a new catalogue on its new pattern (Type G) Franklin air compressors. The different classes are illustrated by large half-tone engravings accompanied by full information regarding details of design and construction. Copies will be mailed upon request.

Machinists Tools.—The Brown & Sharpe Mfg. Co., Providence, R. I., sends a neat folder descriptive of its new line of machinist's tools, including micrometer caliper sets, steel beam trammels, Universal dividers, single and double point scribers, and knife edge straight edges.

Storage Batteries.—The General Storage Battery Co., New York, is distributing its Catalogue A, which describes and illustrates different sizes of Bijur batteries, including the Bijur high duty batteries, which are used for absorbing load fluctuations in elevator service, electric railroads, electric cranes, hoists, etc.

The North-Western Line has published a four-page folder describing the new line to Los Angeles over the San Pedro, Los Angeles & Salt Lake. The train leaving Chicago at 8.02 p.m. arrives at Los Angeles at 7 a.m. the fourth morning out.

Pneumatic Tools for Track Use.—The Ingersoll-Sergeant Drill Co., New York, is distributing its Bulletin No. 2,002, which bears the title "Track Laying on the Williamsburg Bridge." It contains photographs showing the Haesler piston drills as used for drilling rail long holes, etc.

Railroad and Track Supplies.—The Buda Foundry & Manufacturing Co., Chicago, is distributing its 1905 catalogue. In addition

to its large line of railroad and track supplies, the products of its Paige Iron Works special work department are also included. Full information is given regarding all of the products shown, which are made in the company's own plant. The last 13 pages contain useful engineering information. The book is 6 in. x 9 in., has 225 pages and is bound in red leather with gold letters.

Car and Locomotive Replacers.—Bulletin 13 of the Buda Foundry & Mfg. Co., Chicago, describes the Buda car and locomotive replacer. The device is fully described and illustrated. There are also two track views with the replacers in position.

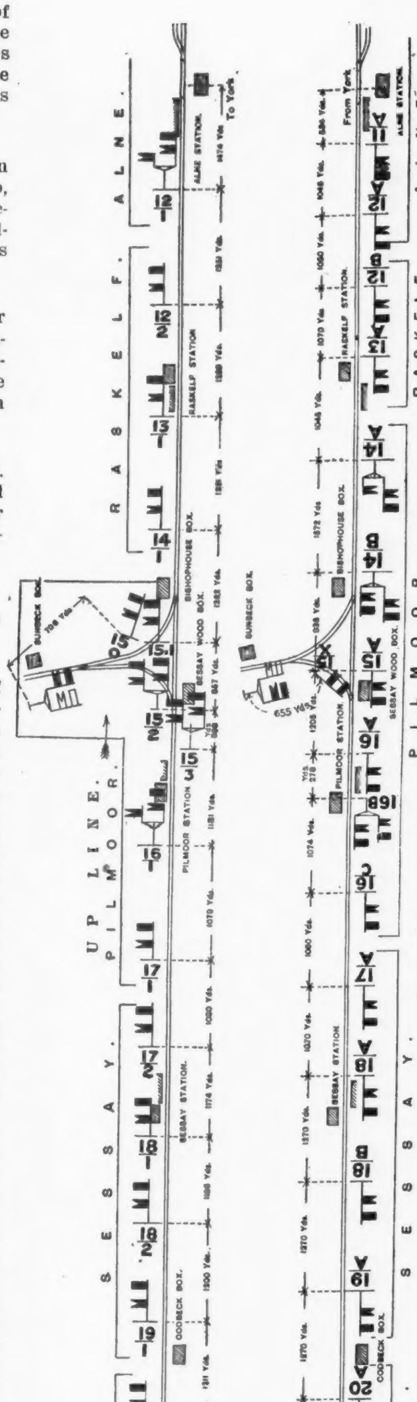
Car Heating Apparatus.—The Chicago Car Heating Co. has prepared, primarily for distribution at the International Railway Congress, a French edition of its catalogue describing and illustrating its vapor system of car heating.

Ventilation.—The Royal Ventilator & Mfg. Co., Philadelphia, Pa., sends an illustrated booklet descriptive of the Royal ventilator and the Royal system of ventilation as applied to shops, train sheds, etc.

Hall Automatic Block Signals on the North Eastern Railway.

The first installation in Great Britain of automatic signals worked by local power—Hall gas signals—was put into operation on the North Eastern Railway between Green Lane signal cabin and Alne Station, a distance of 10.4 miles, on June 4. This is on the main line between Newcastle and York, extending over the junction with the line branching out to Gilling on the east and Knaresboro' on the west. There are two other automatic block installations in operation in Great Britain, both installed by the British Pneumatic Railway Signal Company on the London & South Western Railway. These two installations consist of power operated inter-locking cabins with two or three automatic block sections between the cabins. The first, that between Andover Junction and Grateley, was installed in 1901 (*Railroad Gazette*, Aug. 16, 1901), and the second was put in service in September, 1904.

The tests of the signals on the North Eastern have been extraordinarily protracted and severe. The signals were operated for some six weeks with a man placed at each signal to note any failure or irregularity in operation. After it was found that the general system, that is, the action of the signals themselves, was nearly ideal, most painstaking tests were made of the track circuit. It was found that some of the lighter goods wagons, not equipped with power brakes, would not, singly, invariably short-circuit the current. This failure occurred most often on the fouling section of the sidings and cross-overs. It was also found that under favorable conditions, enough sand could be carefully packed on a section of the track so that an engine would not short-circuit when standing upon it. A great variety of tests of this and other sorts were indulged in, and though nothing was discovered that was not known, all the possible weaknesses of the system were brought to light. Since it was found that every engine and every brake van (caboose) would invariably short-circuit the track and properly operate the signals, the conclusion was finally arrived at that all trains, or the parts of a train broken in two, were safely protected, and the Board of Trade gave its provisional approval so that the signals went into regular operation on June 4.



Hall Automatic Electro-Gas Block Signals on the North Eastern Railway of England.

The accompanying diagram, showing in conventional characters the arrangement of the signals, is taken from the Rule Book prepared by the railroad company for the employees. Only one of the manual block stations is abandoned, that at Codbeck. At Raskelf, Bishopshouse and Sessay, the automatic home and starting signals, with their distants, are controlled by circuit-breaking springs on the signal levers in the cabin. For protection in foggy weather, the Raven fog signal apparatus is connected to the automatic signals. This apparatus strikes a projection on the locomotive and blows a whistle in the engineman's hearing whenever a home signal in the stop position is passed. Besides this protection, the ordinary British practice in case of fogs is brought into service. When a fog comes on in the neighborhood of Alne, Pilmoor or Green Lane, the signalmen at those places must immediately communicate with each other by telephone, and one of them must call up the three stationmasters and have signalmen and trackmen called out for duty; signalmen for the cabins not already manned and trackmen for fogging duty, that is, placing torpedoes on rails to repeat signal indications. Until the intermediate signalmen have reached their respective boxes trains must observe time intervals, as follows: A passenger train following a freight, 20 minutes; a freight following a passenger, 10 minutes. The rule does not prescribe an interval to be observed by a passenger following a passenger, or a freight following a freight.

The block stations which no longer block the trains, but do give information to other cabins, use the ordinary "be ready" signals of the code for giving on the bells the signal "train now passing." Different bell signals are prescribed for the 14 kinds of trains which are named in the English classification.*

The signals, as before stated, are Hall electro-gas, semaphores. They are arranged "normal danger," with a 1,200-ft. overlap. The second home signal in advance and its distant are cleared when an oncoming train passes a home signal. In the ordinary practice this clearing point would be placed at the end of the overlap. The same indication is used at night for both home and distant signals, that is, red for "danger" and green for "all clear," as in the usual English practice. All the switches on this line are already protected by mechanical interlocking. The mechanical signals, as far as they are retained, are controlled by the track circuit by means of the electric slot. Switch instruments are placed at each switch (pair of points) to shunt the track circuit, and, in the case of facing points, to also break the signal circuit. There are indicators and annunciators in the signal cabins to show the approach of a train and also the presence of a train between the home and starting signals.

When a train has been detained by a home automatic signal for one minute the engineman may proceed, with great caution; but if the home signal is at, or near, a signal box, where a signalman is on duty, the signalman's written permission must be first obtained.

All these cabins are connected by a telephone line, and at each station there are telephones to the stationmaster's and track foremen's houses.

*These trains are entered in the code (presumably in the order of their importance) as follows: Express passenger; wrecking train going to clear the line; ordinary passenger train; excursion train; wrecking train not going to clear the line; officers' special; branch passenger train; fish, meat, fruit, horses and cattle; empty passenger cars; then various classes of fast and slow freights; two trains coupled; light engines; work train working in section.

Pacific Locomotive with Superheater for the Erie Railroad.

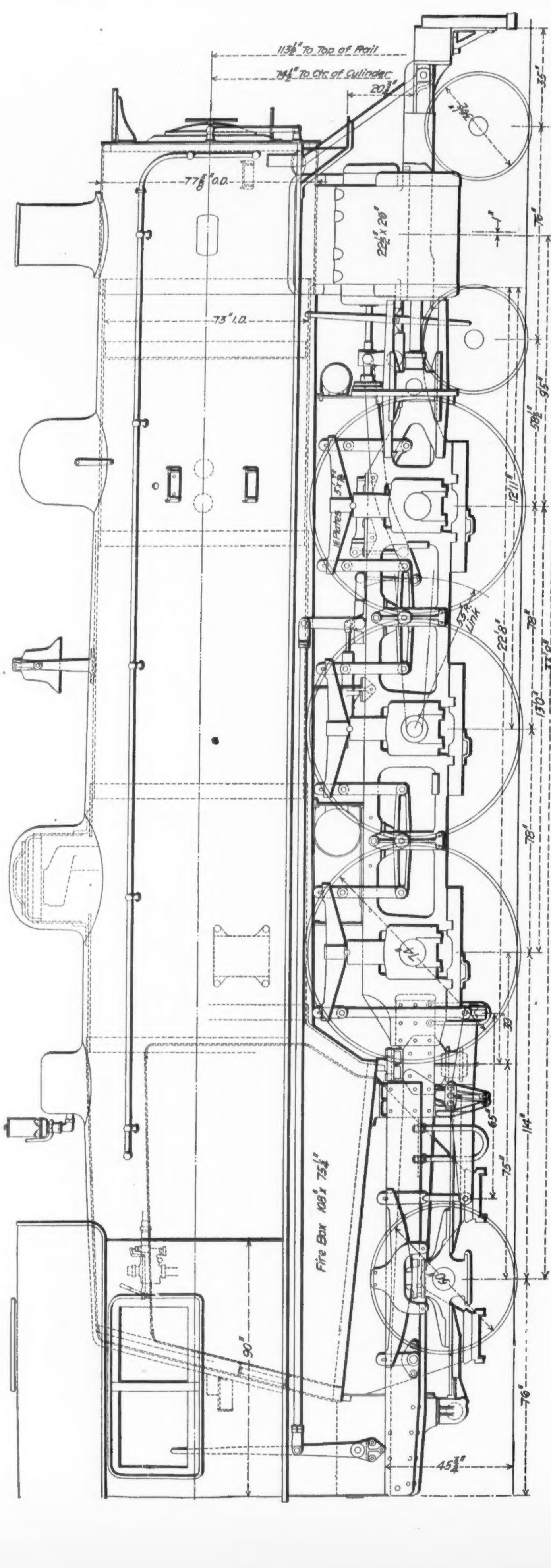
The Schenectady shops of the American Locomotive Co. have recently delivered four locomotives of the 4-6-2 type to the Erie Railroad that have some novel and interesting features. Two of these engines are equipped with superheaters and two are not. The superheater used is that of the Cole or Schenectady design as modified from that shown in the *Railroad Gazette* for Sept. 2, 1904. It will be remembered that in the case of the superheater illustrated at that time, which had been applied to an Atlantic type engine of the New York Central, the enlarged tubes in which the superheater pipes were placed had an outside diameter of 3 in. The outer tube of the superheater had an outside diameter of 1¾ in. and the inner 1$^1/_{16}$ in. There was one nest of superheater tubes in each fire tube, and, in the case of the engine under consideration, there were 55 in all. This gave a total superheating surface of 301 sq. ft.

The modification that has been introduced in the 4-6-2 engines for the Erie consists in enlarging the fire tubes to a diameter of 5 in. on the inside and placing therein four superheater pipes. The outside diameter of the outer pipe is 1½ in. and that of the inner ⅞ in. This somewhat reduces the heating surface for each pipe but increases it very materially for each fire tube. In short, the reduction for each pipe amounts to a little less than 15 per cent., while the actual increase per fire tube is 3.42 times as much. Evidently, however, it would be quite impossible to place 55 of these large tubes in that portion of the shell of the boiler that is available for use with the superheater. Instead, but 32 are used, and these occupy practically the same amount of space as the 55 in. in the New York Central engine. The relative amount of heating surface in the two engines based upon the same length of superheater tubes is as one to two in favor of the latter design. Figures are not yet available as to the degree of superheat obtained or the efficiency of the new design, but it must evidently produce better results than that first put out.

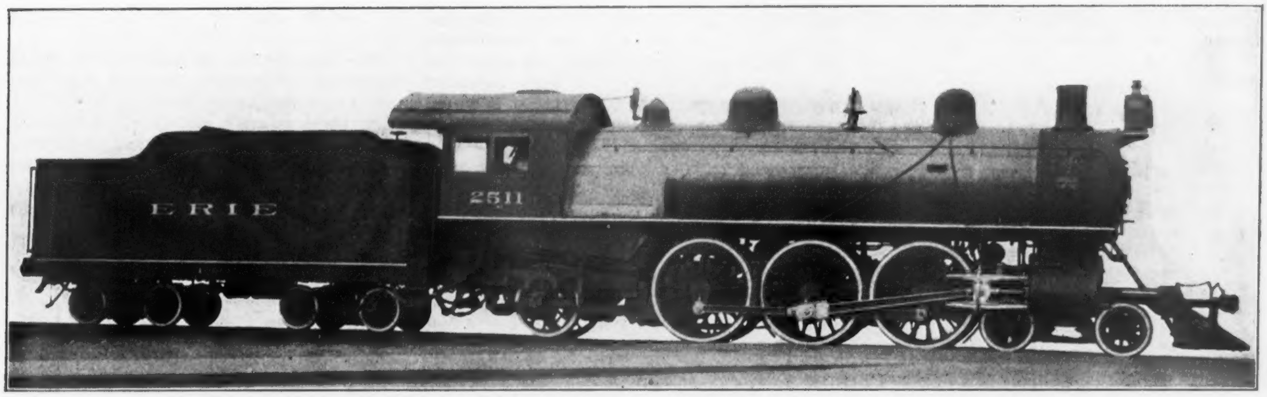
In the matter of the details of the arrangements of the superheater pipes there has necessarily been an essential change from that shown in the first design. In that case the end of the outer superheater pipe was closed and the extended end split and flared so as to form a sort of foot that rested upon the interior of the fire tube. In the new design the ends of the outer tube are forged down solid and form a nub or teat at the end of the pipe ⅞ in. in diameter and 2 in. long that fit into a malleable iron bracket into which it is pinned and which, in turn, rests on the interior of the fire tube. At the front end the two superheater tubes are expanded into the walls of the superheater box or chest.

A copper ferrule $^1/_{16}$ in. thick is used in connection with the outer pipe, and it will also be noticed that the pipes spread as they approach the front end of the fire tube, being bent for the purpose. They are, of course, bent before being put in position. All of these details are clearly shown in Fig. 1, which fully illustrates the arrangement of the superheater pipes. From this it will also be seen that the 5-in. tube is swaged down to an outside diameter of 4 in., where it enters the back tube sheet; into which it is screwed and then beaded on the fire side. Finally, the total heating surface of the superheater as constructed for this engine is 763.75 sq. ft. against 301 sq. ft. in the New York Central engine.

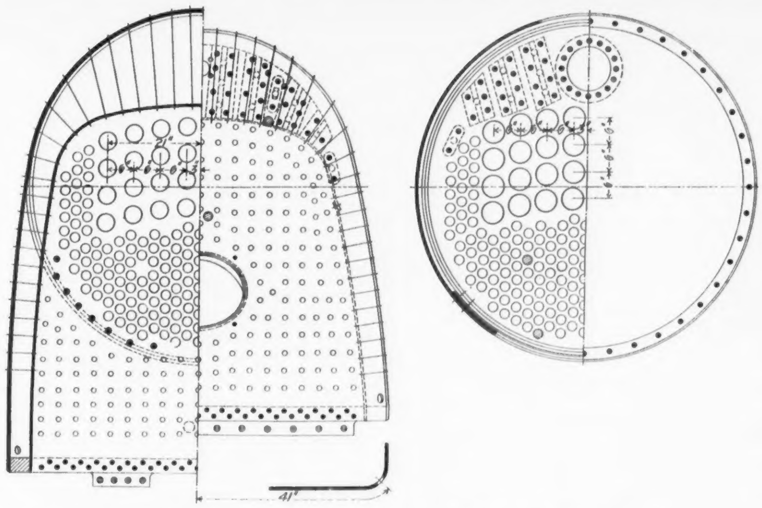
Aside from the superheater the boiler has no novel features. The outside diameter of



Side Elevation of Pacific (4-6-2) Type Locomotive for Erie R. R.



New Pacific Type Locomotive for the Erie R. R.



Tube Sheets of Boiler for Pacific Locomotive for Erie R. R. Showing Location of Superheater Tubes.

the smallest course in the shell is 74⅝ in. and the sheets are $^{13}/_{16}$ in. thick. The circumferential seams are double riveted and the horizontal seam sextuple riveted with butt joints and inside and outside welts. The back head and throat sheet are sloping, as will be seen from the side elevation of the engine. Figs. 2 and 3 show end elevations of the boiler, which illustrate the location of the large fire tubes for the superheater; these being spaced 6 in. apart from center to center in vertical and horizontal rows.

Attention has been called at various times to the influence of the English practice in the use of plate frames on American designs. The use of the plate frame is by no means unknown in this country and its adaptation to the requirements of the wide firebox and the trailing truck is common practice. In this engine the plate frame begins just back of the rear driving wheel and is bolted to the main frame by nine bolts as shown.

The equalization of the weight includes all of the driving wheels and the rear truck. The equalizing bars are carried in cast brackets bolted to both rails of the frame. The hangers straddle the upper rail. The equalizer leading to the truck spring cuts down the load on the latter by about 12 per cent. The arrangement of this rear equalizer is clearly shown on the plan, Fig. 4, which also illustrates the truck. It will be seen from this and the side elevation of the engine, Fig. 5, that the equalizer is located diagonally so as to bring the weight out to the outside bearings, and that the forward end is supported by a cross-bar extending across the engine, which is, in turn, supported by the hangers from the rear driver springs. By this means the bar is kept straight and free from any offset.

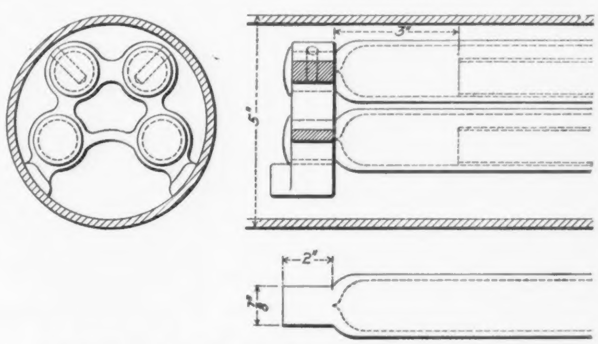
The rear truck is of the Cole radial type that was illustrated and described in the *Railroad Gazette* for Jan. 20, 1905. In this truck it is necessary that the spring and the seat upon which it rests should remain in line with the side frame of the engine. This is accomplished by carrying the seat on rollers that permit the axle box to turn freely beneath the spring seat as it swings out of its central position in passing curves. By this means the adjustment of the trailing wheels to the requirements of the alinement is done without putting any additional stress upon the flanges of the wheels other than that incidental to the guiding of the engine.

The general appearance of the engine is shown in the side elevation of Fig. 5, and the reproduction of the photograph, and the following is the list of dimensions, etc.:

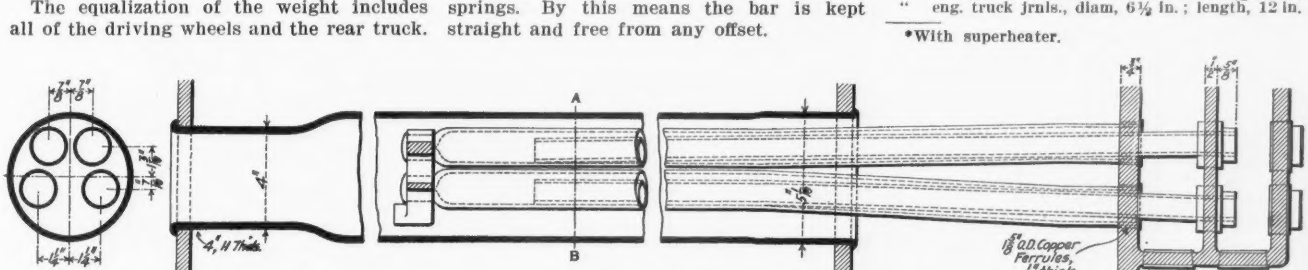
General Dimensions.

Cylinder, diameter	22.5 in.
Stroke	26 in.
Cylinder, type	Simple piston valve
Track gage	4 ft. 8½ in.
Wheel base, driving	13 ft. 0 in.
" " total	33 " 8 "
" " total engine and tender	65 " 1 "
Weight, working order with superheater	230,500 lbs.
" on drivers	149,000 "
" working order, eng. and tendr*	393,500 "
Heating surface, tubes	3,119.59 sq. ft.
" " firebox	202.35 "
" " total	3,321.94 "
" " superheater	763.75 "
Grate area	56.5 "
Axles, driving journals, main	9½x12 in.
" others	9½x12 in.
" eng. truck jrnls., diam, 6½ in.; length, 12 in.	

*With superheater.

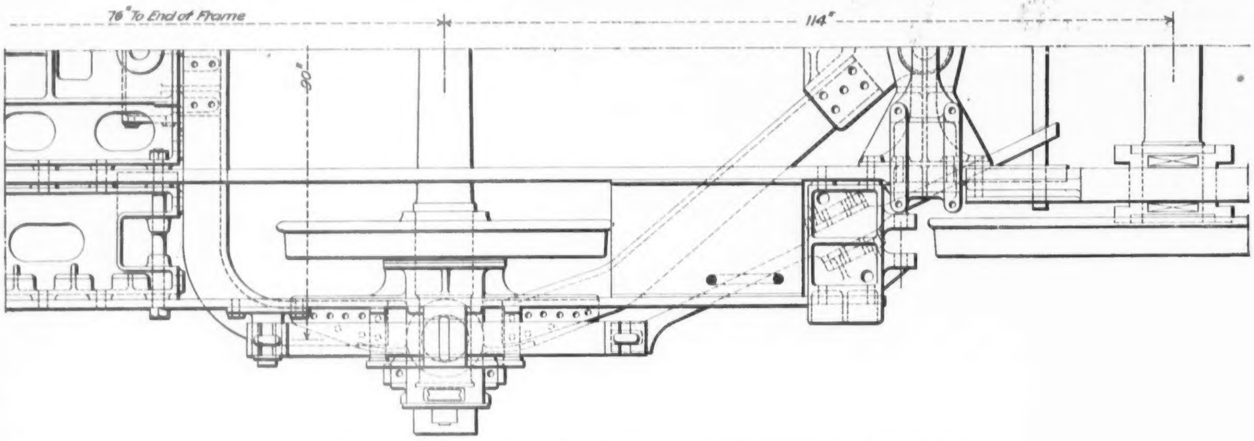


Section of Superheater Tubes for Erie Locomotives.



Arrangement of Superheater Tubes for Erie Locomotive.

Axle trailing truck jour., diam., 8 in.; lgth 14 in.
Axle tendr. truck jour., diam., 5½ in.; length 10 in.
Boiler, type............................Straight top
" outside diameter first ring.........74⅝ in.
" working pressure.....................200 lbs.
" fuel ....Bituminous coal
Firebox, type..........................Wide
" length ....108⅛ in.
" width ....75¼ "
" thickness of crown sheet ....⅜ "
" " " tube sheet ....½ "
" " " side sheets ....⅜ "
" " " back sheets ....⅜ "
" water space front..................4½ "
" " " sides ....4½ "
" " " back ....4½ "
Crown staying ....Radial
Tubes, material ....Charcoal iron
" diameter ....2¼ in.
" diameter ....5 "
" length ....20 ft.
" gage ....11 BWG.
Boxes, driving main ....Cast steel
Boxes, others ....Cast steel
Brakes, driver ....N. Y. High Speed
" truck ....High Speed
" tender ....N. Y. High Speed
" pump ....Duplex No. 2
" air signal ....N. Y. E. S.
Engine truck....4 whl. swing center bearing with spring centering device
Trailing truck ......Radial with outside journals
Exhaust pipe...Single nozzles, 5⅜, 5⅝ and 5⅞ in.
Grate, style.......Rocking to shake, in 4 sections
Piston rod, diameter ....3¾ in.
Piston packing ....Cast-iron rings
Smokestack ....18 in.
Smokestack top above rail. ....15 ft. 2¼ "
Tender Frame....12 in. steel channels and plates; Georgia pine flooring.
Tank, style ....Water bottom
" capacity ....8,500 gal.
" capacity, fuel ....16 tons
Valves, type....piston; diameter ....12 in.
" travel ....6 "
" steam lap ....1 "
" ex. lap. ....C. L. ⅛ "
Setting........Line and line full forward motion
Setting..................¼-in. lead at ¼ cut-off
Wheels, driving, diam., outside tire.........74 in.
" " diam., center ....68 "
" " center, material ....Cast steel
" engine truck, diameter ....36 in.
" " " ....Paige cast-iron spoke
" trailing truck, diameter............50 in.
" trailing truck. ....A. L. Co. C. spoke
" tender truck, diameter ....33 in.
" tender truck ....Paige plate



Plan of Cole Radial Trailer Truck for Pacific Locomotive—Erie R. R.

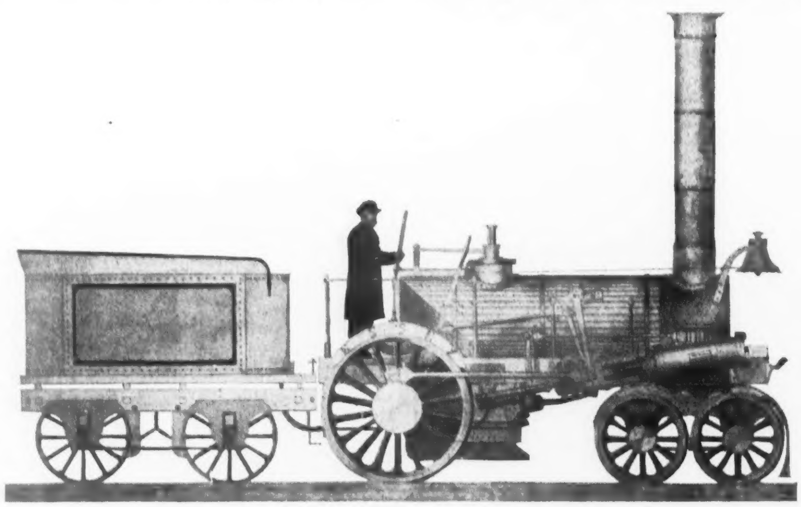
The Locomotive Essex.

At the recent exhibition of railroad appliances the Barnet Equipment Co. showed the original drawing of the locomotive Essex built by Seth Boyden in 1838, of which the accompanying illustration is a reproduction. It had a single pair of driving wheels and was built at Newark, N. J., as a companion engine to the Orange that had been turned out a year or two before. The patterns were made in 1837 by John M. Phillips, one of the founders of the establishment of Hughes & Phillips. He was at that time apprenticed to Seth Boyden and completed his apprenticeship about the time that the Essex was finished.

It is said that the Orange made its first trip over the road from Newark to Bordentown on the morning of July 4, and as the state of the art had not, at that time, developed the spark arrester, the consequence was that a number of barns and dwellings along the road were in ashes when the train passed on its return to Newark. It is stated that the road was nearly forced into bankruptcy by the payment of the losses that were so occasioned. The photograph of the engineer shown is that of O. C. Woolson, Sr., who came to Newark from Lowell, Mass., with several other mechanics and was employed by Mr. Boyden for a number of years.

Another locomotive built by Boyden was run from Newark to Jersey City over what is now the Center street line of the Pennsylvania. It was equipped with an upright boiler and a rotary engine was attached to the axles by means of gearing. Boyden's opinion of the machine is, perhaps, best given in his reply to a question as to how it worked, which was to the effect it needed steam as coarse as horse flies to run through it. It is needless to say that the life of this locomotive was short.

The Orange and the Essex were well designed, durable engines, worked in a very satisfactory manner and were kept in service for many years. It is believed that the Essex was sold to a western road and was finally lost in Lake Erie, having run off from a trestle at Cleveland, O. Nothing is known of the last of the Orange. Unfortunately also there is no record extant of the dimensions or weights of these engines. The outlines of the construction are, however, very clearly shown by the reproduction of the drawing, and this is especially true of the valve gear and main connections.



The Locomotive Essex.

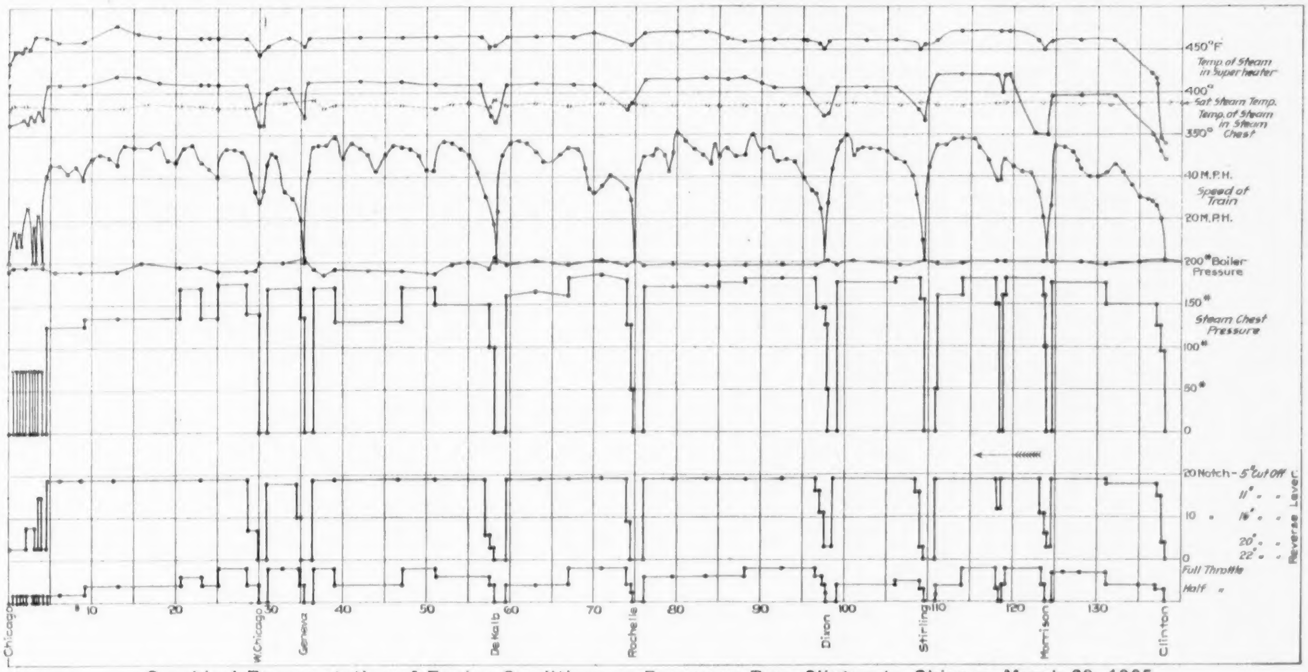
Test of a Superheater Locomotive.

The Chicago & North-Western recently conducted comparative tests of superheater and non-superheater locomotives to determine their relative efficiency. Two sets of tests were conducted, one being in passenger service and the other in freight. In making the tests it was the endeavor, as far as possible, to have the prevailing conditions for the opposing engines as nearly identical as possible. This requirement would include the use of the same engine crews throughout the tests. But unfortunately it became necessary to change firemen during the passenger runs and the variation in some of the resulting figures was such as to cause the rejection of the results from this set of tests. The freight tests, however, were satisfactorily concluded, and the results are given herewith.

The leading characteristics for both types of engines are:

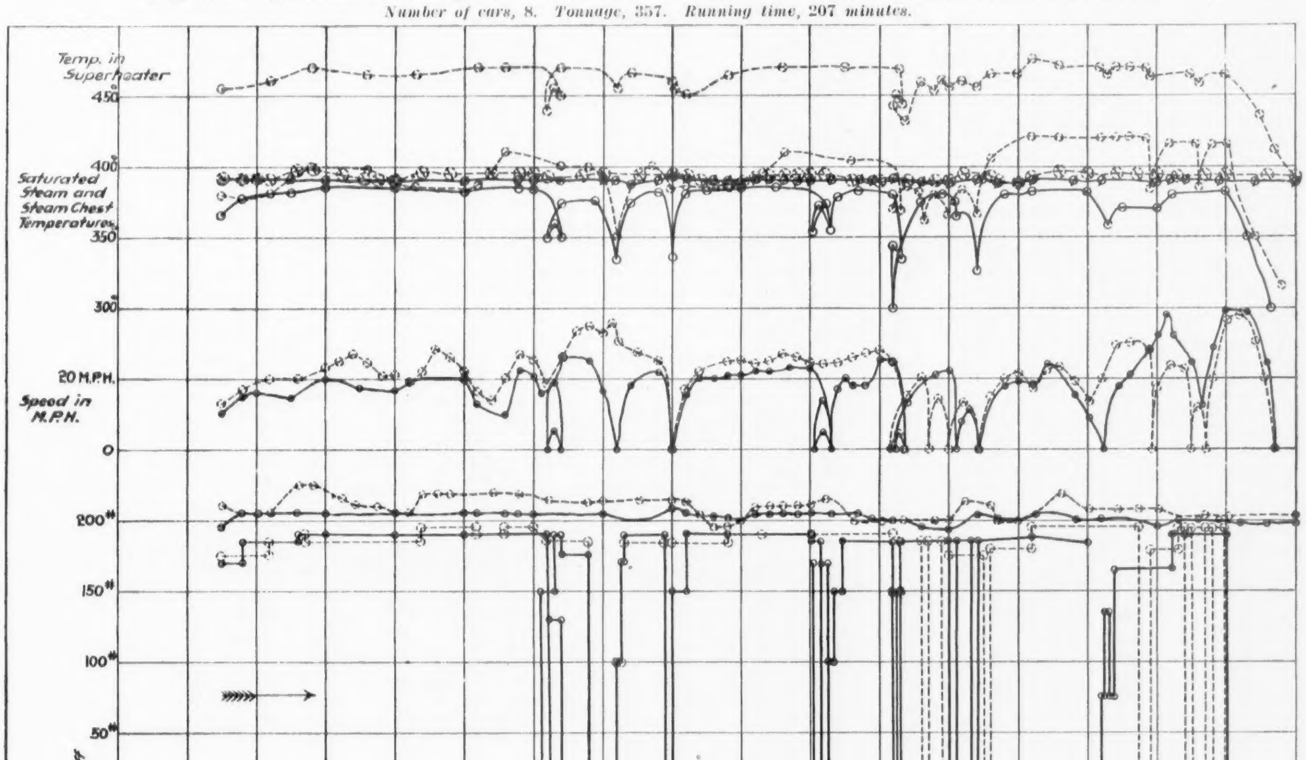
	Passenger.	Freight.
Type	Atlantic.	10-wheel.
Cylinders	20x26 in.	21x26 in.
Diameter drivers	81 in.	63 in.
Weight on drivers ...	91,000 lbs.	126,000 lbs.
H't'g surf., tubes.....	2,549.0 sq. ft.	2,542.8 sq. ft.
" " arch	24.8 "	....
" " firebox ..	172.4 "	154.3 "
Totals............	2,746.2 sq. ft.	2,697.1 sq. ft.
Htg. surf., superheater	261.4 sq. ft.	255.7 sq. ft.
Htg. surf., grate area.	46.6 sq. ft.	46.6 sq. ft.

Both types have piston valves. The superheater is the original Cole design of the American Locomotive Company, having forty 3½-in. tubes in which the superheater tubes are contained. The freight runs were made between Chicago and Milwaukee, and



Graphical Representation of Engine Conditions on Passenger Run, Clinton to Chicago, March 29, 1905.

Number of cars, 8. Tonnage, 357. Running time, 207 minutes.



Graphical Representation of Engine Conditions in Comparative Tests of Superheater and Non-Superheater Freight Locomotives, C. & N. W.

Superheater Engine shown by Broken Line; Non-Superheater shown by Full Line.

records were kept of the coal and water used, boiler pressure, position of throttle, position of reverse lever, and pressure and temperature in the steam chest; also on the superheater locomotive the temperature of the steam in the superheater was taken. The amount of work performed was obtained by means of a dynamometer car next to the engine, its records enabling computations to be made of the running time, the distance the engine was worked under steam, the mean drawbar pull, and the total foot pounds of work delivered by the locomotive. Also, record was kept of the number of cars, the tonnage and the ton miles. Four trips were made with each locomotive, two each way. The final results were as follows:

Locomotive	Superheater.	Non-superhtr
Mean drawbar pull, lbs.	13,677	14,000
Total ft.-lbs. delivered..	5,284,214,500	5,282,720,000
Lbs. coal used	17,900	19,150
Lbs. water used	89,050	97,512
Water evap.,per lb. coal	4.97	5.07
Work, per lb. of coal..	295,207	275,860
Work, per lb. of water*	48,639	44,520
Ave. running time,mins.	248.2	275.2
Horse-power	637.2	577.9
Lbs. water, per h.-p. hr.	33.7	36.4
Lbs. coal, per h.-p. hr..	6.7	7.2

*At 212 degrees.

Taking the figures for work delivered per pound of coal, the superheater engine shows an advantage of 7 per cent., and for work per pound of water, an advantage of 9.2 per cent. These figures are, of course, only approximately accurate, as, being a road test, no account was taken of, or corrections made for, steam used by the air pump and blown off at the safety valve, or water and steam wasted by the injector, etc. The per cents are therefore higher than the theoretical figures, but they represent accurate results for road work.

A graphical representation of the various locomotive conditions during two individual runs of the freight tests is shown in the accompanying diagram, the superheater locomotive being represented by the broken line in each case and the non-superheater by the solid line. The most interesting of the records are those showing the superheater temperature and the steam chest and saturated steam temperatures. The latter are the calculated temperatures corresponding to the slightly varying boiler pressures, in each case making approximately a straight line across the sheet. The steam chest temperatures for the non-superheater will, of course, always be below this line, while for the superheater the expectation would be, for the most of the time when the engine is using steam, to find them above the saturated steam line. This condition is more clearly shown in the chart for one of the passenger runs which is also reproduced. The saturated steam temperatures are indicated by the broken line. The maximum superheat in the steam chest is about 35 deg., although the average will come perhaps 6 or 8 deg. under this. For the freight locomotive the difference is considerably less. While a maximum of about 30 deg. is shown, for the greater part of the run little advantage is noticeable, particularly in the early part, where for the first 20 miles the steam-chest line is mostly below the saturated steam line. The train was an extra, however, starting with a heavy "drag" but arriving at destination with only about 60 per cent. of the initial load.

Both diagrams show a temperature in the superheater averaging 75 or 80 deg. of superheat. Since the maximum shown in the steam chest of the passenger engine is only 35 deg., a loss of 40 to 45 deg. under the most favorable conditions is disclosed, and the average is considerably greater than this.

The information regarding these tests was furnished us by courtesy of Mr. R. Quayle, Superintendent of Motive Power and Machinery of the Chicago & North-Western.

Roundhouse Framing.*

It is not claimed by the writer that the following designs and specifications for roundhouses are entirely new and original and certain inconsistencies are also recognized: For example, in the concrete-steel design there is shown a wooden monitor. This might more appropriately be made of fireproof materials. However, the greater distance from the floor raises the question whether or not such additional expense is warranted. It might be added that the monitor shown should be dowelled or otherwise fastened to the sill girder. The cast-iron door posts, of course, may be made of structural steel design.

The use of cast-iron door posts is justifiable, however. They can be made economically of greater thickness, and thus be less affected by corrosion. The brittleness of cast-iron occasionally seems to be an actual advantage. An engine recently jumped the track on leaving the turntable, and carried away the cast-iron door post. Although the brick arches fell, the roof merely sagged somewhat, cracking along the lines of the adjacent bays. Had the post been of structural material, particularly if connected with the truss, the two bays of the roof would undoubtedly have been pulled down. Wooden doors seem to the writer to be preferable, both on account of cost and resistance to corrosion, when compared with steel doors of either the rolling or ordinary type. Lifting wooden doors, in themselves, are a neater looking contrivance than the old swinging type, and should be subject to fewer collisions. They are more likely to get out of order from minor accidents, however, and require a greater height of building at the interior wall. Within limits, the entrance doors should be of ample width, as they are likely to be injured either by a blow from a damaged cab, or on account of carelessness in fastening.

Apart from the question of fire, wooden roundhouses would seem to have an advantage in cost and life over anything except a protected or concrete-steel design. The question of fire may be a very serious one, but appears to be over-rated. Proper water connections, in cases where the house is constantly in use, should greatly reduce this danger. As will be noted by an examination of the different designs, light and ventilation have been made important factors. In these days a good working light is rightly regarded as of great importance in all shops. Better results from labor, ease of inspection —indeed, less need of inspection—and a superior condition of cleanliness and order, are directly traceable to proper lighting. As a roundhouse is one of the places peculiarly in need of ventilation, a generous supply of smoke exits is true economy. Any corners in the roof, or purlins running across the slope and thus acting as baffles to the smoke, are very undesirable. The designs shown have been made to eliminate this trouble as far as possible. In the old-fashioned roundhouses it is frequently almost impossible to see the roof sheathing on account of the smoke. The condition of light riveted-iron trusses in such an atmosphere should not need demonstration. Under such circumstances, from 10 to 15 years is probably the maximum life of the roof. The writer knows of several cases where trusses under similar conditions were literally falling to pieces at the end of that period. If steel is to be used, beam sections having a greater thickness of material than the small angles frequently used, and which are more readily painted and inspected, should be used in the design. In any case, periodical inspection and painting are absolutely necessary.

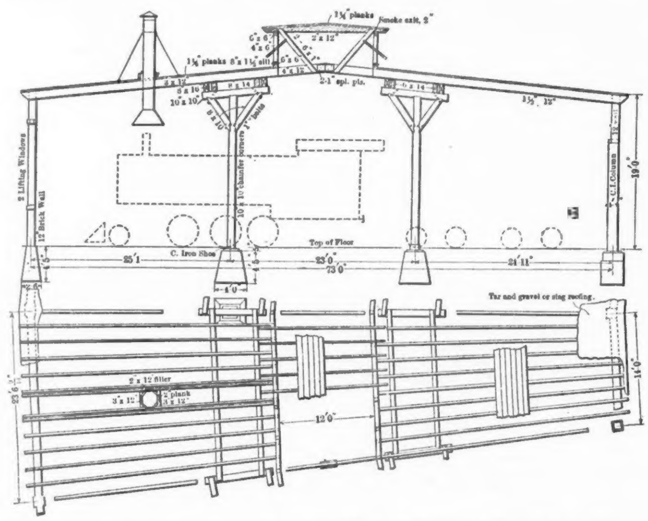


Fig. 1—Timber Framed Roundhouse.

Smoke-jacks have been constructed of a variety of materials. Wood, cast-iron, tile and asbestos have given satisfactory results. Smoke-jacks of thin, rolled plate have a very short life, and, in the writer's estimation, are not worth installing. Wood lasts rather better than might be expected, and, in connection with a fireproof roof, should prove economical and safe. It is not necessary to sand the interior, though the exterior should be well painted. Cast-iron, if heavy, has a fair length of service. Tile is more expensive, and its weight and liability to break, if detachable, are objectionable features. Asbestos is light in weight and is fireproof, but is more expensive in first cost. The smoke-jacks shown on the drawings are not intended to represent any particular type. A telescoping jack, provided with a bell having a diameter of about 4 ft., would be the writer's preference.

Gutters and down-spouts, while necessary in some localities, are often omitted. In any case, thin metal should not be used, as corrosion marks them for an early grave. In cold climates the down-spouts may advantageously be carried down inside the house to connect with the pit drainage system.

In designing a reinforced concrete roof, the question arises, will the gases penetrate hair cracks, and attack the metal? Such

*A paper presented to the American Society of Civil Engineers, May 3, by R. D. Coombs, Assoc. Mem. Am. Soc. C. E., and reprinted from the *Proceedings* for April, 1905, Vol. XXXI., No. 4.

cracks, though invisible, will probably be present in any design, unless it is abnormally heavy. The writer is of the opinion that no failure need be apprehended from this cause.

Certain of the large roads are now building roundhouses, arranged to serve partly as shops, by installing overhead cranes and hoists. It is suggested that a portable gantry crane might be used in houses where it is not desirable to incur the expense of a regular overhead installation.

The writer submits herewith a suggestion for a steel, expanded metal, and concrete design.

The unit prices given in the following tables will vary, of course, in different localities and at different times. Such differences in cost, combined with local conditions, might render one of the more expensive designs in reality economical.

The loading and stress limits used are given in Table 1.

Table 1.—Loads and Unit Stresses.

Dead load = Weight of material.
Wind and snow, wooden house = 25 lbs. per sq. ft.
Wind and snow, concrete-steel house = 30 lbs. per sq. ft.

Unit stress	Wood design...	Purlins.	900 lbs.
		Girders.	1,200 "
	Steel design...	Purlins.	10,000 "
		Long girders. ..	9,000 "
		Short girders ..	9,700 "
	Concrete-steel .	Steel	16,000 "
		Concrete	800 "

Table 2.—Quantities for Wooden Roundhouse, One Bay.

Items.	Quantities.	Prices.	Am'ts.
Roof and Center Columns.			
Monitor sheathing* .	380 ft. B.M.	$35.00	$13.30
" purlins, pine	320 "	40.00	12.80
" fr'm'g, cyprs	345 "	60.00	20.70
Roof sheath'g,spruce.	1,512 "	35.00	52.92
Roof purlins, pine...	2,238 "	40.00	89.52
Girders, pine	675 "	40.00	27.00
Columns and caps..†	601 "	40.00	24.04
Fram'g, bridging,etc*	65 "	40.00	2.60
Bolts	70 lbs.	.03	2.10
Pivot windows.‡	8 each.	4.00	32.00
Fixed windows.‡	2 each.	2.50	5.00
Column foundation.§.	2.92 cu. yds.	6.00	17.52
Roofing	1,513 sq. ft.	.04	60.52
Smoke-jack		.....	30.00
Painting	4,200 sq. ft.	.0225	94.50
C.-I. column base...	700 lbs.	.0275	19.25
Total for roof and center columns....			$504.77
Walls.			
Brick wall	12.5 cu. yds.	$6.50	$81.25
Brick arch	1.8 "	8.00	14.40
Cast-iron column ...	3,200 lbs.	.0275	88.00
Wall foundation	7.2 cu. yds.	6.00	43.20
Post foundation	1.46 "	6.00	8.76
Lifting windows.‡...	2 each.	10.00	20.00
Window fr'm'g, cyprs	200 ft. B.M.	60.00	12.00
Double door.‡		.....	50.00
Total for walls......................			$317.61
Total for one bay			$822.38

Table 3.—Quantities for Steel Framed Roundhouse, One Bay.

Items.	Quantities.	Prices.	Am'ts.
Roof and Center Columns.			
Monitor sheathing* .	380 ft. B.M.	$35.00	$13.30
" purlins, pine	320 "	40.00	12.80
" fr'm'g, cyprs	345 "	60.00	20.70
Roof sheathg, spruce.	2,330 "	35.00	81.55
Nailing strips, spruce	135 "	40.00	5.40
Steel columns.	1,550 lbs.	.03	46.50
Purlins	7,600 "	.03	228.00
Girders	1,900 "	.03	57.00
Knees, etc.	450 "	.03	13.50
Bolts and fillers	100 "	.03	3.00
Pivot windows.‡	8 each.	4.00	32.00
Fixed windows.‡ ...	2 each.	2.50	5.00
Column foundation.§.	2.26 cu. yds.	6.00	13.56
Column f'ndat'n, cap.	0.14 "	10.00	1.40
Roofing	1,470 sq. ft.	.04	58.80
Smoke-jack		.....	30.00
Pa:nting, steel	1,250 sq. ft.	.01	12.50
Painting, wood	1,900 "	.0225	42.75
Total for roof and center columns....			$677.76
Walls.			
Brick wall	12.5 cu. yds.	$6.50	$81.25
Brick arch	1.8 "	8.00	14.40
Cast-iron columns ..	3,100 lbs.	.0275	85.25
Wall foundation	7.2 cu. yds.	6.00	43.20
Post fndatn, concrete	1.0 "	6.00	6.00
Post foundation, cap.	0.25 "	10.00	2.50
Lifting windows.‡...	2 each.	10.00	20.00
Window fr'm'g, cyprs	200 ft. B.M.	60.00	12.00
Double door.‡		.....	50.00
Total for walls			$314.60
Total, one bay			$992.36

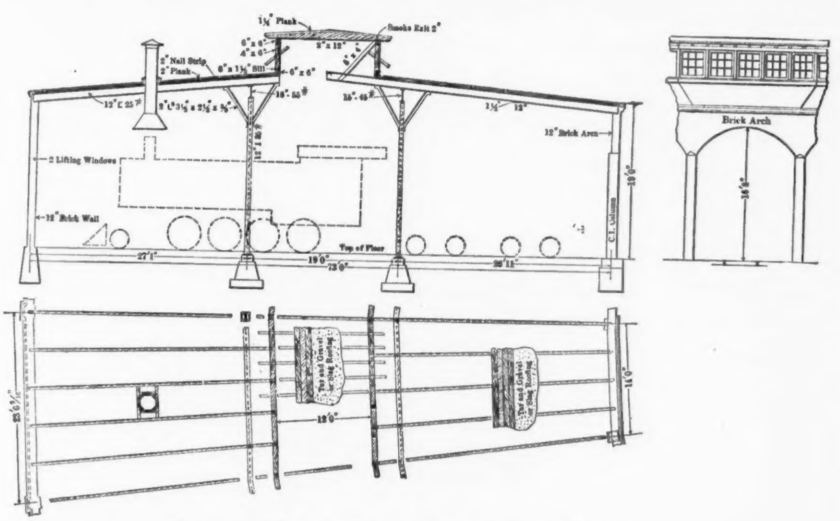


Fig. 2—Unprotected Steel Framed Roundhouse.

Table 4.—Quantities for Concrete-Steel Roundhouse, One Bay.

Items.	Quantities.	Prices.	Am'ts.
Roof and Center Columns.			
Rods	3,770 lbs.	$0.03	$113.10
Concte, superstructre	42.59 cu. yds.	15.00	638.88
Concte, col. bases...	2.3 "	6.00	13.80
Monitor purlins, pine	410 ft. B.M.	40.00	16.40
" shthg, sprce	420 "	35.00	14.70
" frame, cyprs	280 "	60.00	16.80
Pivot windows	8 each.	4.00	32.00
Fixed windows	2 each.	2.50	5.00
Roofing	1,440 sq. ft	.04	57.60
Gutter	38 ft.	.16	6.08
Down-spout	18 ft.	.30	5.40
Smoke-jack		.....	30.00
Painting	700 sq. ft.	.0225	15.75
Total for roof and center columns.....			$965.51
Walls.			
Rods	640 lbs.	$0.03	$19.20
Channels	350 "	.03	10.50
Cast-iron column....	2,330 "	.0275	64.07
Exp. metal, No. 10..	215 sq. ft.	.027	5.80
Concte, superstrctre..	6.42 cu. yds.	15.00	96.30
Concrete foundations	7.09 "	6.00	42.54
Concrete d'r-post c're	0.74 "	6.00	4.44
Lifting windows ...	4 each.	10.00	40.00
Window frame, cyprs	400 ft. B.M.	60.00	24.00
Double door		.....	40.00
Total for walls.			$346.85
Total for one bay.			$1,312.36

*Spruce. †Pine. ‡Including painting. §Concrete.

SPECIFICATIONS FOR WOODEN ROUNDHOUSE.

Foundation.—The foundation shall be of concrete masonry and brick, to suit local conditions.

Brick Walls.—The brick shall be good, sound, hard-burned brick, well laid and bonded. The mortar shall be of Portland cement and sand in proportions of 1 to 2.

Lumber.—All lumber shall be of the best quality, thoroughly seasoned and surfaced on all sides.

Sheathing	Matched spruce.
Cross-bridging	Spruce.
Window framing	Cypress or white pine.
Sash	Cypress or white pine.
Doors	Cypress or white pine.
All other lumber......	Long-leaf hard pine.

Lintels and Caps.—Lintels and sills for wall windows, and cap stones for columns and door-posts shall be of granite (or other suitable stone found in the locality), dressed evenly and having all exposed surfaces six-cut.

Windows.—The windows shall have box frames. Both sashes shall be hung with best flax sash-cord, steel-axle pulleys and iron counterweights; and shall be provided with strong sash locks. The glass shall be of second-quality, double-thick, American, thoroughly bedded, bradded and back-puttied. The pivot windows shall be provided with suitable stops, steel axles and approved operating device, and shall operate from the floor of the house.

Doors.—Each half-door shall have four wrought-iron hinges, and one bolt and chain to the pair; door-stop and drop-bolt at the bottom properly fastened to the floor; and strong thumb-latch. A latching post shall be set in front of each door post, and suitable heavy hooks provided to hold the doors open. Certain specified doors shall have small entrance doors opening outward.

Paint.—All nail and screw heads shall be punched and puttied before painting, and all bolt-head countersinks shall be swabbed with tar. All woodwork shall receive two good coats of white lead and oil.

Roofing.—The roofing shall be of three thicknesses of tarred felt, laid over resin-sized sheathing paper, and covered with a uniform thickness of pitch and slag.

SPECIFICATIONS FOR ROUNDHOUSE OF CONCRETE-STEEL DESIGN.

Steel.—The steel shall be open-hearth.

Ultimate tension	62,000 to 68,000 lbs.
Elastic limit	55 per cent. of ultimate.
Elongation	22 per cent. in 8 in.
Sulphur	0.05 per cent.
Phosphorus	0.06 " (Acid).
Phosphorus	0.04 " (Basic).

The steel shall be free from oil, dirt and rust. Care shall be taken to obtain a good contact between the steel and the concrete; and the position of the rods, as shown on the drawings, shall be carefully maintained. The coarser material in the concrete shall be excluded from under the rods.

Concrete.—The concrete shall be mixed in the following proportions: 1 part of Portland cement, 2 parts of sand and 4 parts of stone.

Cement.—******, or other approved brand of Portland cement, shall be used.

Fineness: Residue by weight on No. 100 sieve, not more than 5 per cent.

Residue by weight on No. 200 sieve, not more than 25 per cent.

Initial set: Not less than 30 minutes.

Tensile strength of 1 sq. in., neat:

1 day........................	200 to 300 lbs.
7 days.......................	500 " 600 "
28 days......................	600 " 700 "

The cement, otherwise, shall be in conformity with the specifications, for Portland cement, of the American Society for Testing Materials. The tests will be made in conformity with the standards recommended by the Special Committee on Uniform Tests of Cement, of this society.

Sand.—The sand shall be clean, coarse and sharp, and free from silt or loam.

Stone.—All stone shall be hard, sound limestone, free from dirt or dust. In the

superstructure no stone shall be more than ¾ in. in any dimension; and, in the foundation, no stone shall be more than 2½ in. in any dimension.

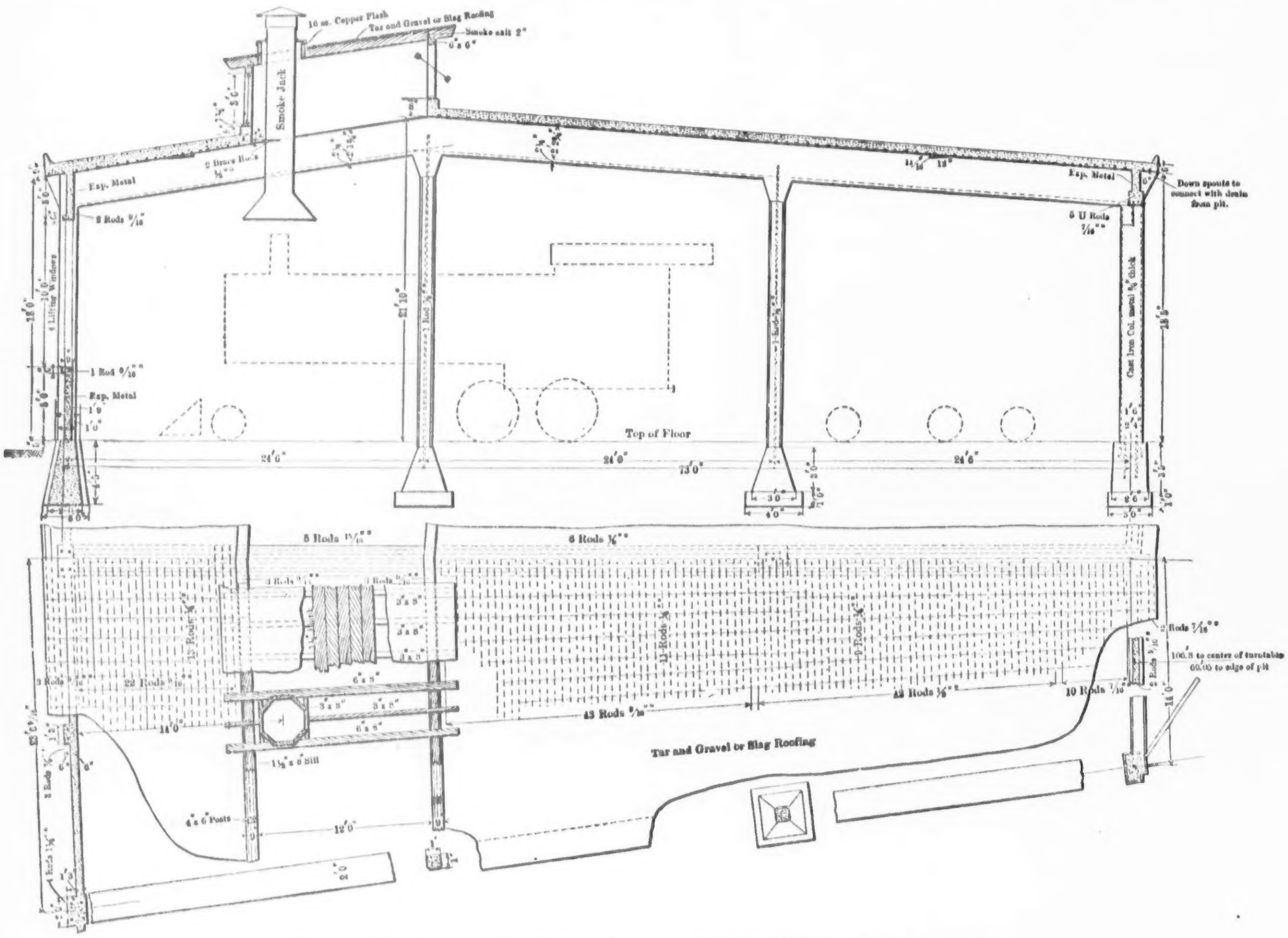
Mixing.—The concrete shall be thoroughly mixed in the specified proportions immediately before using, and any which has begun to set shall not be used. The stone shall be thoroughly wetted before mixing. The sand and cement shall be well mixed before adding the stone and water, and the whole shall be mixed again until the stone is thoroughly coated. The consistency of the concrete shall be such that water rises to the surface without ramming, and the mass "quakes" when additional quantities are thrown in.

Forms.—The supporting forms shall be practically unyielding under loads or ramming. Facing planks shall be dressed on one side and two edges, and closely jointed. The forms shall be left in place for four weeks, and after removal the exposed surfaces of the structure shall be rubbed down or troweled with cement mortar to remove irregularities. The lagging shall be sprinkled at intervals to prevent shrinkage.

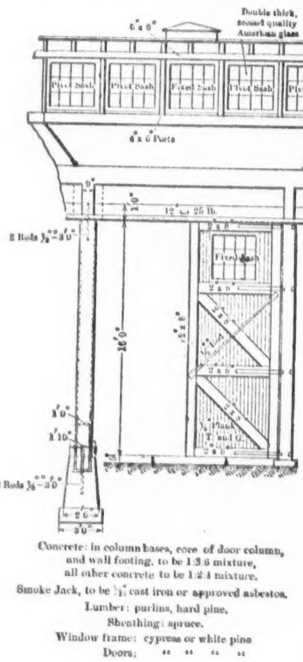
Laying Concrete.—The concrete shall be laid in 6-in. layers (except as hereinafter specified), and rammed. The coarser material shall be worked back from the forms so as to bring an excess of mortar to the face. Each column, girder, sill and lintel shall be laid continuously, *i.e.*, on each of these, work shall not be stopped until it is completed. The roof slabs shall be laid in one layer and continuously from girder to girder. On laying new work adjoining that which has already set, the latter shall be cleaned and wetted and cement mortar placed between. To join girders on walls already set with roof slabs, they shall be left rough to form a bond with the slabs. No concrete in the superstructure shall be laid in freezing weather. Finished surfaces shall be sprinkled daily for a week, and kept covered with straw or canvas for three weeks. Completed portions shall not be loaded with materials or used as walks.

Expansion.—Over every fourth girder there shall be a halved joint in the roof slab, separated by two thicknesses of heavy roofing felt.

Roofing.—The surface of the roof shall be well swabbed with coal-tar pitch, and covered with three layers of roofing felt laid with overlapping joints. Each layer shall be swabbed with pitch, and over the top surface thus made there shall be spread a uniform coating of pitch and slag (or gravel).



Plan and Section of One Bay of Concrete-Steel Design for Roundhouse.



Elevation of One Bay of Concrete-Steel Roundhouse.

SPECIFICATION FOR CONCRETE FLOOR.

After excavating to the required depth, the subsoil shall be thoroughly compacted with heavy rammers. On this surface 4 in. of 1:3:6 concrete shall be laid and also an additional 2 in. of wearing surface composed of 1:2:4 concrete, finished with a 1 to 1 Portland cement and sand surface. These layers shall be laid as one layer and given a 2-in. crown between the pits.

SPECIFICATION FOR BRICK FLOOR.

After excavating to the required depth, the subsoil shall be thoroughly compacted with heavy rammers to a practically level surface. On this shall be laid a 4-in. bed of good "dead end" cinders, rolled with a roller weighing not less than one ton. Above this shall be placed 2 in. of sand thoroughly rolled. On this surface, which shall be given a 2-in. crown between the pits, shall be laid the brick floor. The brick shall be the best quality of hard-burned, machine-pressed, paving brick, laid closely together, on edge, breaking joints.

The floor shall be given a final rolling to an even surface, and the joints shall be filled with 1 to 1 Portland cement mortar.

Relative Efficiency Tests of Friction and Spring Draft Gear.

An interesting exhibit at the Appliance Exhibition in Washington was that of the Standard Coupler Company, maker of the Sessions Standard friction draft gear. This company exhibited a model testing machine with which it demonstrated the relative efficiency of the spring and friction draft gear. The machine was especially designed to demonstrate the relative efficiency of spring and friction draft gears in absorbing heavy or light shocks, and also to show the advantages gained by the use of a high resistance gear as evidenced by a greatly reduced stress at the point of attack, that is, the draft sills and attachments.

In the full-sized Sessions-Standard friction draft gear there are two M. C. B. 19,000-lb. draft springs. These have about 38,000 lbs. ultimate resistance when placed in ordinary twin or tandem construction. By interposing the frictional elements it is shown that this resistance is increased to from 120,000 to 140,000 lbs. In the testing machine there was used a one-quarter size working model of the draft gear, similar in all respects to the full sized gear, and containing two springs to represent the M. C. B. springs referred to.

To show the efficiency of the two springs under the drop, they were placed on a solid bed plate and a tup weighing about 7 lbs. was dropped on them. By means of a recorder, which gave the movement of the follower, the height of drop necessary to close the springs was determined. The springs were then placed in the friction draft gear and a similar test was made, with the result that while it took 5¾-in. height of drop to close the two springs, it required about 20 in. to close the friction draft gear.

In order to illustrate the value of this resistance at different points in the stroke of spring or friction gears, the bottom follower, on which the gear to be tested rests, was connected with a system of levers in the base of the testing machine, so that the pressures were recorded by the vertical position of a pen resting on an indicator drum. The movement of the gear was obtained by means of a hand-operated lever and was transferred to a rotary motion of the drum, thereby forming a card.

Fig. 1 represents the testing machine with the twin-springs in position for testing.

Fig. 2 shows the testing machine as it is operated to make a card. Fig. 3 shows a card made by the friction gear, and Fig. 4 shows a card made by the two springs removed from the friction gear and tested as a twin spring gear.

An examination of the cards in Figs. 3 and 4 shows the friction gear to have a little over three times the resistance to buffing or draft shocks at all points of compression, while the recoil line is considerably below that of the springs. Upon this point of high resistance, with low attendant recoil, the

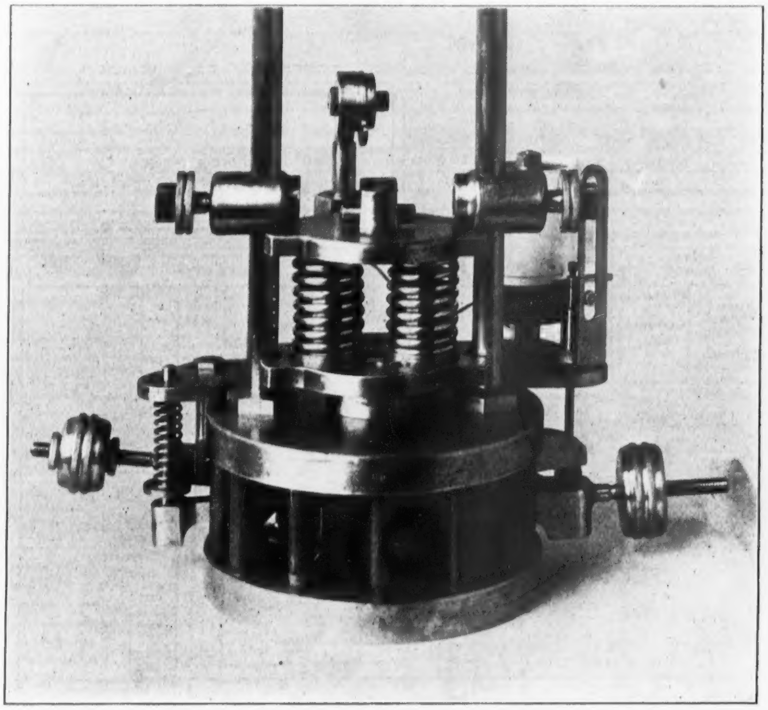


Fig. 1—Enlarged View of Base of Model Testing Machine—Twin-Spring Gear in Position for Test.

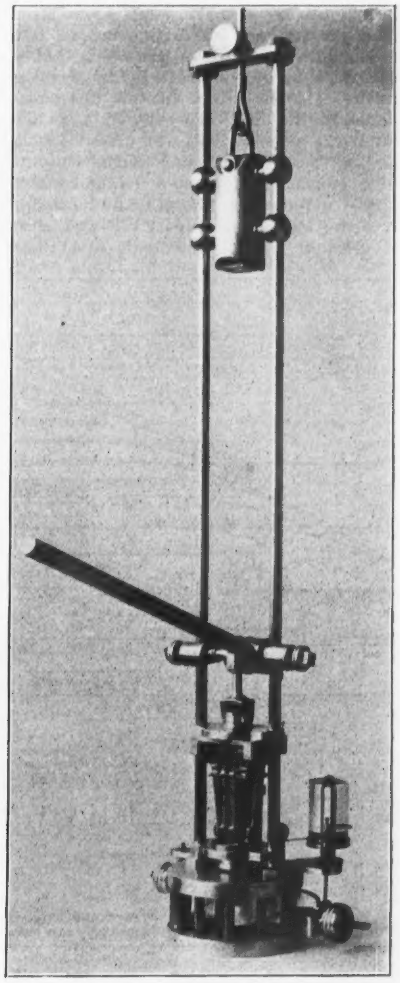


Fig. 2—Model Testing Machine as Fitted for Making Cards—Friction Gear in Position for Test.

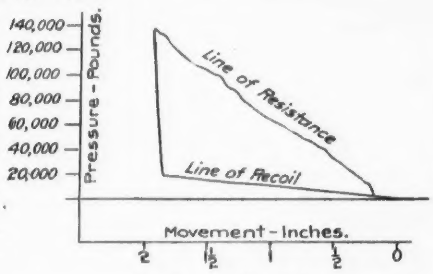


Fig. 3. Friction Gear.

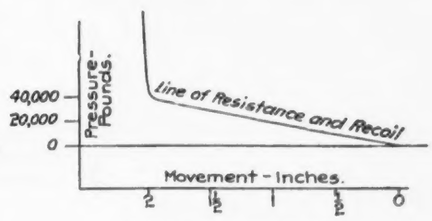


Fig. 4. Twin-Spring Gear.

Comparative Efficiency Cards of Spring and Friction Draft Gear.

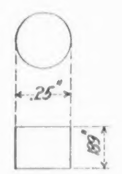


Fig. 5.

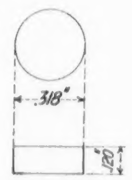


Fig. 6.

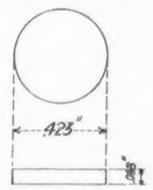


Fig. 7.

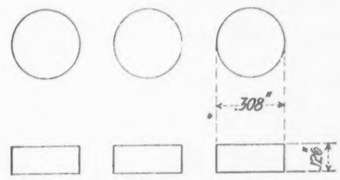


Fig. 8.

Comparative Crushing Effect of Spring and Friction Draft Gears.

friction draft-gear makers lay great stress.

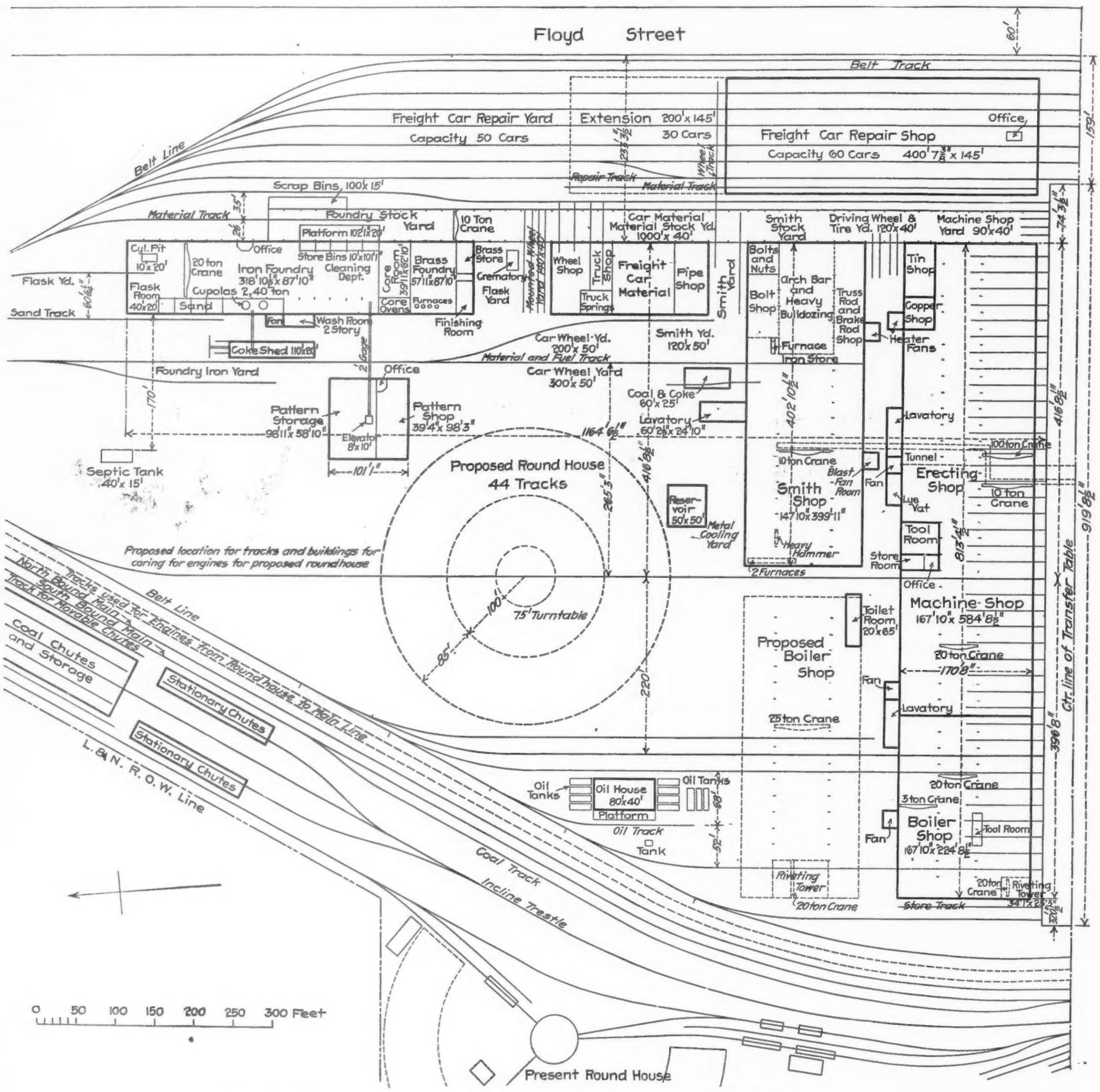
Perhaps the most interesting test made on this machine, at least to the average observer, was that of illustrating the decreased tendency (by the use of friction draft-gear) to damage the sills. To show this, a small cylindrical piece of lead was placed beneath the draft gear to be tested and a weight of 7 lbs. was dropped from a height of about 21 in., compressing the gear and crushing down the lead upon impact. Fig. 5 shows the original size of the leads and Fig. 6 shows a lead which was subjected to a blow when placed beneath the friction draft gear. Fig. 7 shows the increased effect produced upon a similar lead placed under the two springs, the weight having fallen the same distance. An examination of these figures shows that the lead is crushed considerably more when placed under the twin or tandem gear than when placed under the friction gear. How much more this means in decreased stress on the car sills is illustrated when three pieces of lead (Fig. 8) are placed beneath the spring gear and are crushed down under the blow nearly the same amount as in the case of the one piece placed under the friction gear.

The "lead crushing" test is a novel one and the results shown by it are as tangible as have ever been obtained in a comparative test of friction and spring draft gears, and it clearly shows by direct evidence the marked efficiency of the friction gear over that of the spring gear. A repetition of the above test will be given at Manhattan Beach by the Standard Coupler Company during the Master Mechanics' and Master Car Builders' conventions.

New regulations concerning bridges have been issued by the Austrian authorities, and all such structures must have their strength calculated according to its provisions. All existing structures must be minutely examined and tested within six years and the results reported to the government bridge inspectorate. These tests will be made first on main lines.

Grouping and Operating Conditions of the South Louisville Shops.

The fine new shop plant of the Louisville & Nashville at South Louisville, Ky., is nearing completion and is expected to be in full operation this coming summer. Some of the departments are already at work and others will be started as the equipment is placed. The size of this plant and the thoroughness and care with which all details have been worked out and followed up make it one of the notable railroad shop plants of the country. It embodies a great many features which constitute departures from established ideas and practice, and which are designed to minimize the costs of the different classes of work performed. The plant is the product of the ideas of Mr. T. H. Curtis, Superintendent of Machinery, who began the work while Mechanical Engineer of the road. The layout was made by him personally and an analysis of the grouping and the operating conditions will be of interest.



South Louisville Locomotive and Car Shops of the Louisville & Nashville.

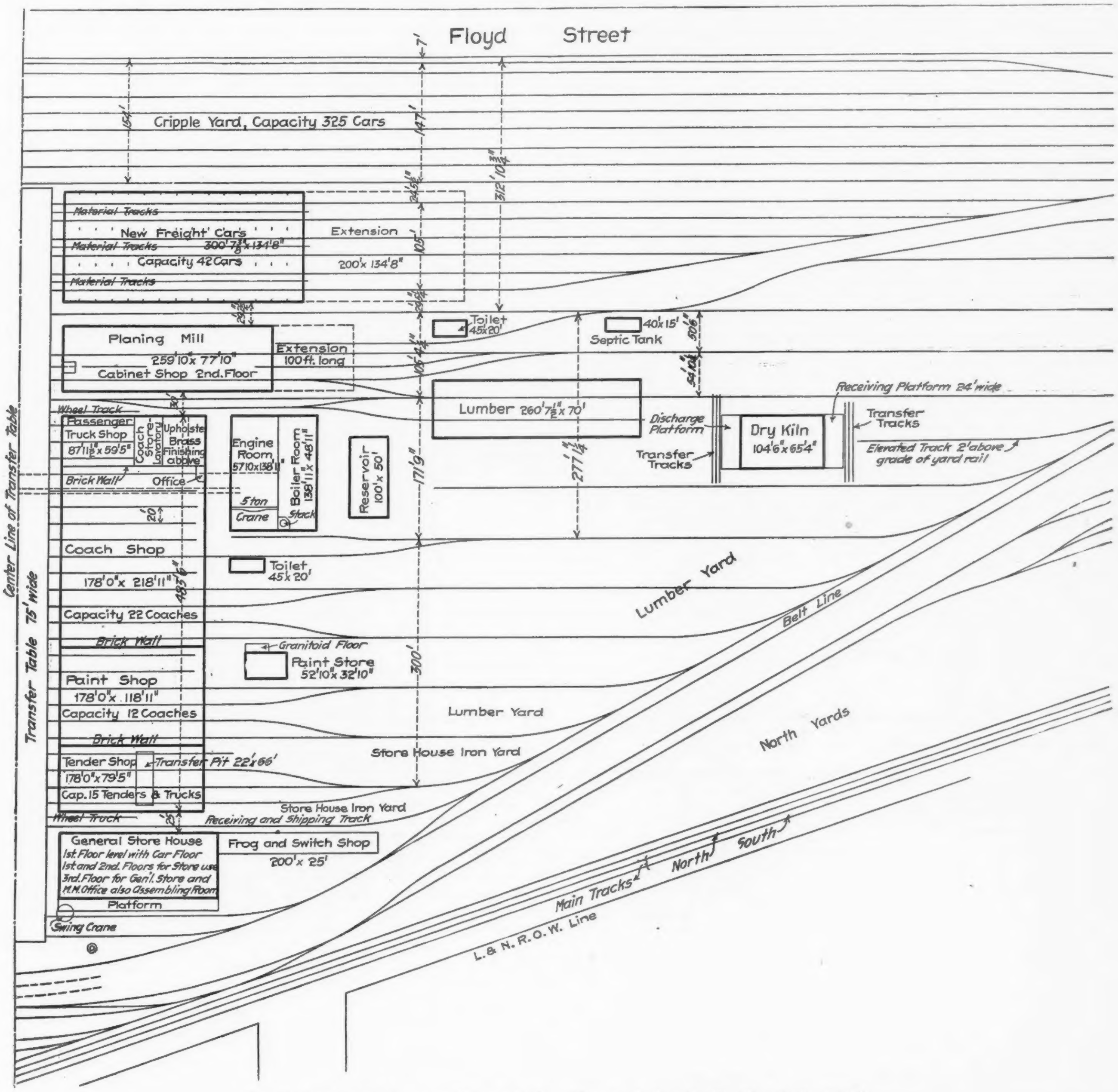
The principal features of the plan are three, namely, (1) the long, pointed, fish-shaped yard layout, with its greatest dimension north and south; (2) a wide, rapid-moving transfer table with pit extending east and west almost entirely across the yard and dividing it approximately into halves; (3) a long, rapid-moving stock-yard overhead traveling crane with runway extending from the transfer table northwardly 1,000 ft.

The primary consideration governing the general plan and the grouping was that the metal should enter the yard from the north end and the lumber from the south end, and that there should be no reverse movement in the general progress of the material from point of entrance to point of consumption or storage. The key feature of the plant is the stock-yard crane, which has a span of 40 ft., a clearance of 15 ft. and a maximum speed of 1,000 ft. p. m. All metal-working buildings are grouped along and are directly connected with this crane and deliver their products to it. Each building is equipped with overhead electric traveling cranes, which, with one exception—the foundry—move in an easterly and westerly direction; the arrangement being such that they may readily receive from and deliver to the stock-yard crane. As its name denotes, materials of various sorts are stored in the area served by this crane.

All wood-working shops are ranged along the transfer table. The lumber is stored at the south end of the yard; tracks also lead up to the dry-kiln. The arrangement is such that there is no need to handle the lumber from the time it is loaded on bunker cars, either from the yard or from freight cars, until it is put through the machines in the mill. The lumber progresses northward by stages through the dry-kiln, planing mill, etc., to the transfer table for distribution. This table is capable of the same maximum speed as the stock-yard crane—1,000 ft. p. m.

It will be noted that the freight car repair shop is on the north side of the table adjoining the stock-yard crane. This location was chosen because of the opportunity it afforded for the expeditious delivery of material to this shop. The exposure in the direction of crane travel is 400 ft., with provision for increasing to 600 ft. Material for this shop is stored in building No. 8, between the foundry and blacksmith shop, its stock room being a sort of sub-station to the general storehouse. This building also contains the wheel and truck shop and the pipe shop. Loose wheels are stored in the space immediately west, whence they may be brought in quickly, machined and mounted on axles. They are then run out to the stock-yard, picked up by the crane and either placed in the mounted-wheel storage yard adjoining at the north, where use of the crane enables them to be stacked several tiers high, or else they are set down in front of the truck shop and run in. The finished trucks are run out, picked up by the stock-yard crane and transported to the transfer table, which quickly distributes them to the proper tracks in the new freight car shop.

The yard for storage of crippled cars is directly south of the freight car repair shop. Its standing capacity is 325 cars, and all of its six tracks lead directly to and through the freight car repair shop, and



South Louisville Locomotive and Car Shops of the Louisville & Nashville.

the freight car repair yard to the north of the latter. Emergency cripples, however—that is, loaded cars with perishable cargoes, for instance—can be run around on the belt track and shoved into the repair yard or shop from the north for immediate attention.

This belt line, as its name denotes, encircles the entire yard inside of the fence, and is an important agent for the free handling, receipt and delivery of supplies, material, etc. The large number of straight tracks running partly or entirely the length of the yard will also be noted, all of which have connection with the belt track. The store-house is located close to this track and to the transfer table. It is the general store for the entire road. Interchange of material between it and the stock-yard crane is accomplished by means of a special car which is carried on the transfer table. A swinging crane at the northwest corner of the store-house facilitates handling material to and from the table.

The layout is made to permit 33 per cent. expansion to all buildings. Also, there is space for a separate boiler shop when it is required, and also for a 44-stall roundhouse. When the former is built, the tender shop will be moved across from building No. 3 into the locomotive shop.

The foundry is the only department in full operation at this writing, and two views of it are shown herewith. Some idea of the excellence of the entire plant may be gained from a brief description of this department. The building, which is approximately 444 ft. x91 ft., is brick and steel with an unusually high roof of saw-tooth design. It is divided into three departments, principal of which is the iron foundry, the other sections being the core room and brass foundry, as shown in the plan. A 20-ton electric overhead crane traverses the full length of the building. A special track from the belt line is provided on the west side of the building for the sand and scrap-iron cars, the former being unloaded into bins in the building and the latter stored in the space west of the track. Another track west of this one leads past the coke shed. All raw material thus enters the building from the west side. A narrow-gage track leads from the coke shed across a scale just outside of the foundry building, to an elevator between the two 40-ton cupolas. This elevator contains a turntable to enable the cars to be run off in any one of the several different directions. The coke cars run off the elevator on a landing platform and dump into a bin betweet the two cupolas. The narrow-gage track also has a branch to the scrap-iron yard and the same cars and elevator convey the iron to the charging floor of the cupolas. All material, flasks, castings, etc., within the foundry are handled by the crane, of course. The rattlers are located on the platform at the middle of the east side of the building. This platform is 10 ft. inside and 20 ft. outside of the building. The rattlers are run at night, each day's product being cleaned the following night. The castings are conveyed by the crane in large metal pans or "baskets" from which they are dumped directly into the rattlers. When cleaned they are dumped back into these baskets and set by the crane on the floor for the chippers. The latter take them out of one basket and throw them into another, which is picked up by the crane and placed on a small car on the platform, which is shoved outside either for loading into the cars or to enable the basket to be picked up by the stock-yard crane for distribution to the buildings along its runway, or conveyance to the transfer table. Small castings are stored in bins on the loading platform until needed.

The pattern storage building is of large capacity and is fireproof. It has an elevator in the center and a narrow-gage track leads from the latter to the foundry. A cheap and satisfactory form of storage rack has been devised for the patterns. The uprights are 3-in. iron pipe to which are bolted cast-iron arms having on each side a series of short lugs over each of which the flattened end of a 2-in. boiler tube will just fit, forming the shelves. Scrap tubes are used for these shelves. The racks may be made any length desired by the addition of sections. They are three shelves high.

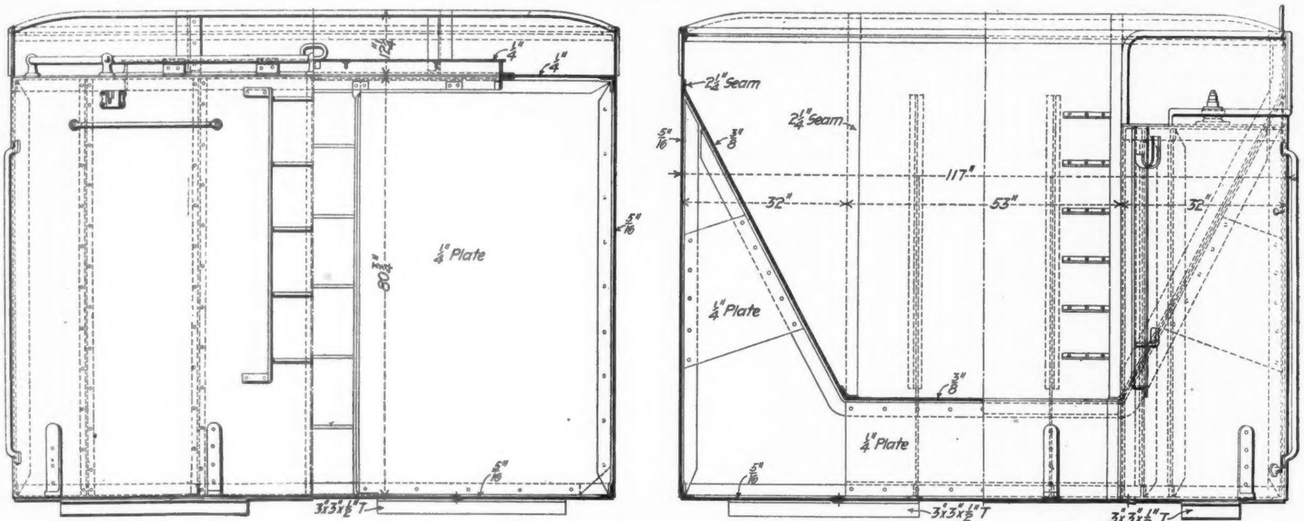
We are indebted to Mr. Curtis for information for the foregoing.

The Prussian State Railroad authorities have been testing an air-brake for freight trains known as the "Knorr brake." Trains of 100, 110 and 120 axles (the axle and not this car is regarded as the unit in Germany), were equipped, the engine being connected by telephone with the inspection car at the end of the train, and such trains made round trips over a section 55 miles long. The brake can be set from some of the cars as well as from the engine. The result of the trials is reported to have been satisfactory, but no details are yet published.

Large Tenders on the Lehigh Valley.

The constantly increasing size of locomotives for both freight and passenger service has necessitated a proportional increase in the size and capacity of the tender, for with long non-stop runs it is necessary to carry enough coal to last from three to four hours and on roads not equipped with track tanks a large supply of water must also be carried. Five years ago the average coal and water capacities of tenders were 5,000 to 6,000 gallons and eight to ten tons, respectively. On the Lehigh Valley, the tenders of the new 10-wheel fast freight locomotives recently put in service have a capacity of 7,500 gallons of water and 16 tons of coal. These tenders have a number of new and interesting features which are shown in the accompanying drawings.

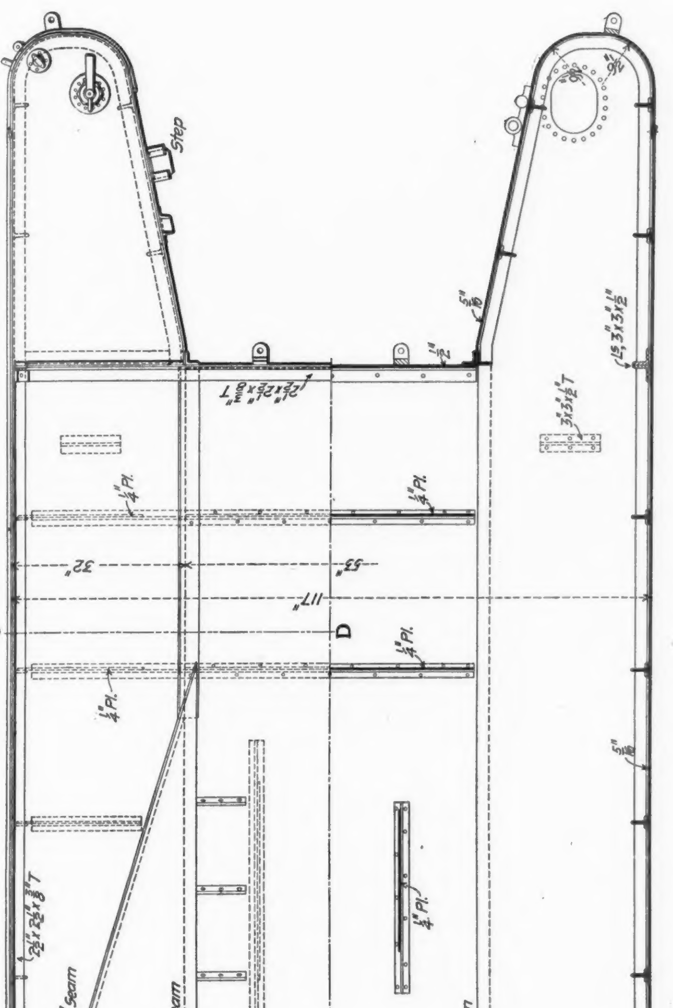
The tank is 24 ft. 6 in. long, 9 ft. 9 in. wide and 7 ft. 6 in. high from top of frame to top of coal bunker. It is U-shaped but the coal space is made self-clearing with sloping back floor sheets and side sheets so that all the coal runs down to the apron without shoveling. The tank is built up of ¼-in. steel plates with light angle connections and T-iron stiffeners riveted on the inside of the side sheets. Plates ⅜-in. thick are used for the sides and bottom of the coal space to better resist wear and corrosion. The back water space is 5 ft. 9 in. long and 6 ft. 8¾ in. deep. Its top surface is flat and only a light pipe railing is carried around the edge so that coal falling down on it drops off the sides. The manhole is 18 in. wide and 6 ft. long, which allows a variation of about 12 ft. in spotting the tender under a water crane. No swash plates are used in any part of the tank.



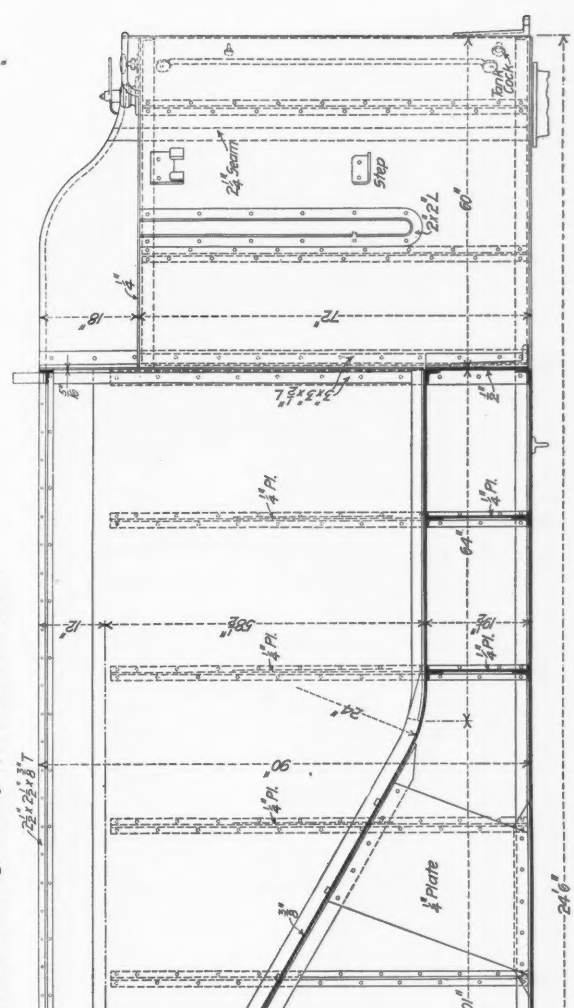
Half Back Vew. Section A-B. Section C-D. Half Front View.

Part End Elevations and Cross-Sections of Lehigh Valley 7,500 Gallon Tender.

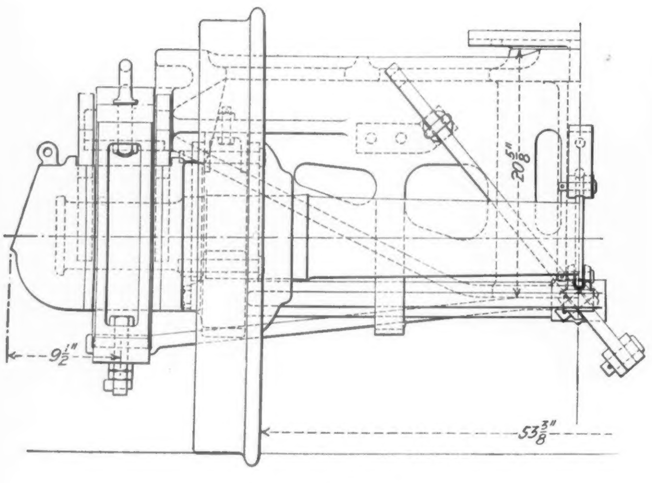
The tender frame is made correspondingly heavy and strong. It consists of four longitudinal sills which are 12-in. channels, wood end sills backed with 1-in. plates, built-up bolsters, and three intermediate transoms between the bolsters. Diagonal braces 2½ in. in diameter extend from the middle of the center sills to the ends of the bolsters and from the end sills to the side sills outside the bolsters. The bolsters are built up of a 1-in. x 10-in. top plate, a 1½-in. x 10-in. bottom plate, and a 1-in. x 10-in. plate extending across from the bottom of the side sills and carrying the side bearings. For the intermediate transoms 1-in. plates are used, the center transom being 6 in. wide and the other two 5 in. wide. The engine coupling is attached by a 3-in. pin to a heavy steel



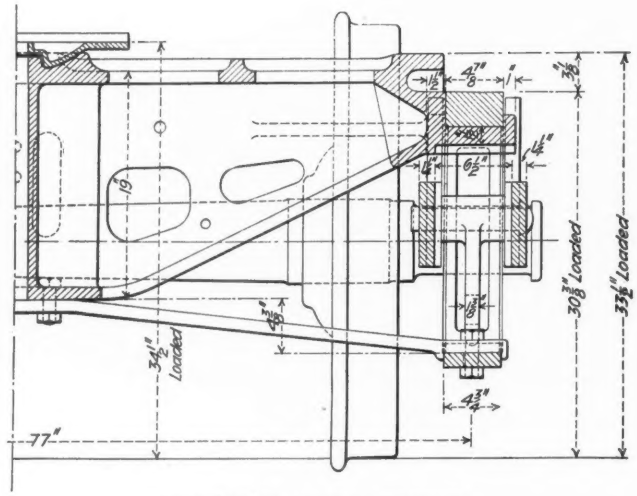
Part Plan and Section of Lehigh Valley 7,500 Gallon Tender.



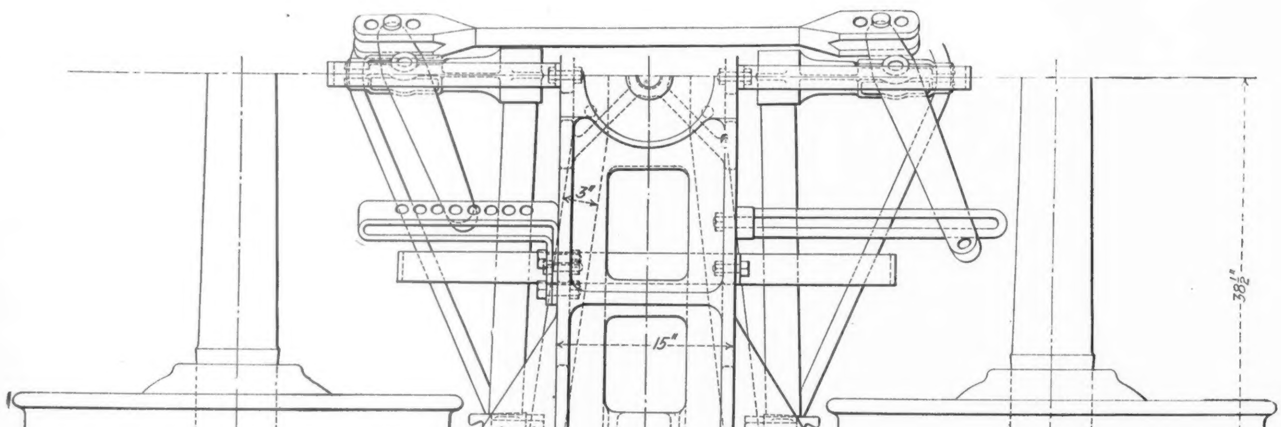
Longitudinal Section through 7,500 Gallon Tender—Lehigh Valley.



Half End Elevation.



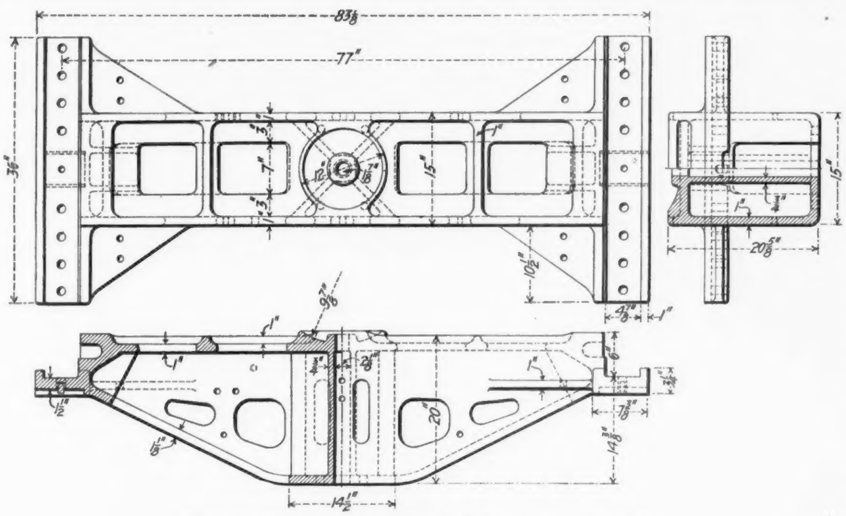
Cross-Section through Transom.



Plan and Side Elevation of Equalized Tender Truck—Lehigh Valley.

casting riveted in between the center sills just outside of the bolster.

For a tender of this size, the design of a suitable truck is important. The experience of Mr. A. E. Mitchell, Superintendent of Motive Power of the Lehigh Valley, led to the conclusion that the only safe design of truck for such a large tender intended to be often run at high speed, was a truck having equalizers. The drawings show the details of the trucks which have been specially designed for these tenders. They have 5½-in. x 10-in. journals, 36-in. Paige wheels and cast-steel transoms. The top bar of the side frame is 2⅞ x 4⅞ in. and the bottom tie-bar is 1¼ in. x 4¾ in. The equalizers are double and are 1¼ x 7 in. at the center, spaced 6½ in. apart to clear the side frame. The spring hanger links are suspended from 2-in. pins spaced 38 in. apart. One of the drawings shows the special heavy cast-steel transom used. This construction gives a rigid truck with few parts in which there is practically no side play. The wheels are equally loaded under all conditions of track and the danger from derailment is greatly lessened.



Detail of Truck Transom, Lehigh Valley Tender.

We are indebted to Mr. A. E. Mitchell, Superintendent of Motive Power of the Lehigh Valley, for the drawings.

Locomotive Requirements of American Railroads.

In the *Manufacturers' Record* of April 13 was an article entitled "Enormous Transportation Facilities Fail to Keep Pace with the Country's Traffic Demands," in which it was pointed out that with an increase of freight tonnage during seven years from 1890 to 1897 of about 36 per cent., and a further increase during the seven years from 1897 to 1904 of about 82 per cent., the increase in the number of locomotives during the same periods was only about 16 per cent. and 24 per cent., respectively. Assuming an annual depreciation of 10 per cent. in the efficiency of the 44,529 locomotives now in service on existing lines, exclusive of the requirements of new mileage to be built, and exclusive of further increase in traffic, it was reasoned that some 4,600 new locomotives are required each year to maintain the present power in undiminished efficiency. Also it was suggested that for the 6,000 miles of new road building annually, equipment at the rate of one locomotive for each five miles is needed, making an additional demand for 1,200 locomotives, to which must still be added whatever is necessary to supply the increasing annual tonnage. The need for something like 6,000 locomotives a year as a minimum would thus be indicated, together with a constant increment in this number with the further expansion of the railroad mileage and tonnage of the country. The question is raised as to whether existing locomotive shops have the capacity to supply this demand.

In May 25th number of the same journal, Mr. Alba B. Johnson, of the Baldwin Locomotive Works, after briefly summarizing the points of the previous article as above, writes as follows:

There are several considerations which appear to be elements of this problem to which I would like to call attention. A locomotive is not subject to an annual reduction of efficiency. So long as its boiler is in condition to carry the pressure for which it was designed, and so long as the locomotive is maintained in a proper state of repair, it is capable of doing its maximum work. With the great improvements which have been made in boiler construction there should be no necessity for reducing the working pressure until the locomotive is, from other causes, about ready for withdrawal from service. There is not, therefore, an annual reduction of 10 per cent., nor of any other percentage, by reason of the depreciation of the efficiency of existing locomotives. The percentage of reduction of power caused by the retirement of old locomotives is much less than the ratio which the number of such locomotives bears to the whole number in service, because most of the locomotives now being withdrawn from service are light in weight and obsolete in type. Experience has shown that at intervals of about 20 years there come revolutionary changes in railroad equipment. Thus we have seen the transition of carloads from 20,000 to 40,000, from 40,000 to 60,000 and from 60,000 to 100,000 lbs. capacity each, accompanied by corresponding changes in the weight of rail and in the capacity of locomotives. So certain is the further development of railroad science that it is unsafe for any railroad manager to count upon the efficiency of the best-known appliances for a period more than 20 years in the future. Modern locomotives should maintain their maximum efficiency for at least 20 years, and should then be available for a good many years' service on branch lines. The depreciation is therefore less than 5 per cent., and instead of 4,600 locomotives being required annually to make good the depreciation in existing equipment, approximately 2,300 will be sufficient.

The locomotives now doing the greater portion of the work of the country have been built during the past 10 years. They are of enormously greater capacity than those which they have replaced. Twenty years ago the heaviest standard freight locomotive had a weight on driving wheels of from 100,000 to 110,000 lbs. At present the average weight on driving wheels of heavy freight locomotives is about 180,000 lbs., an increase of fully 75 per cent. Comparing the traffic in ton-miles and the locomotives as units, without reference to the individual capacity of the latter for producing ton-mileage, appears to show great disparity, but when 50 per cent. to 75 per cent. is added to the effective value of these units much of the disparity disappears.

One of the most conspicuous facts in railroad work during the past few years has been the vast sums spent in reducing grades, straightening curves and otherwise so improving the conditions of traffic as to reduce the power required for its movement. Such reduction of grades and curves is equivalent to a large increase in the effective capacity of locomotives, while the introduction of gravity yards also largely reduces switching engine mileage. It is difficult to convert this into the terms of a definite percentage of increased locomotive power, but it must be a very considerable factor both in increased efficiency and in reduced cost of operation, and tends to lessen the number of locomotives required for a given freight tonnage.

The average number of miles of track per locomotive for the whole country is approximately five, but this includes all of the old-established lines where traffic is concentrated and trains are numerous. Rarely do new roads provide themselves so liberally with power; one locomotive for each 10 miles of track is nearer to the usual allowance. Therefore, 600 locomotives per annum should be sufficient to provide for new construction of 6,000 miles.

It is difficult to determine just what number of new locomotives is required annually to provide for increase of traffic, exclusive of renewals of existing equipment and equipment for new mileage. During the seven years from 1897, when the total number of locomotives in the country was 36,080, to 1904, when the total number of locomotives in the country was 44,529, the increase was 8,449, or an average of 1,207 per annum. This annual increase, of course, covered also new mileage and increased tonnage. It would be a liberal allowance to assume that 1,000 locomotives per annum are required for increasing tonnage.

Summarizing the foregoing, the total requirements of American railroads appear to be:

Number required for renewal of existing equipment	2,300
Number required for equipping new mileage	600
Assumed requirements for increasing annual tonnage	1,000
	3,900

During the year 1903 the American Locomotive Co. built in its eight shops 2,216 locomotives and the Baldwin Locomotive Works built in their shops in Philadelphia 2,022. Although having contracts sufficient to operate to their maximum capacity throughout that year, a number of causes contributed to prevent both concerns from realizing their maximum production. Both were engaged largely in rebuilding their shops and both were greatly hampered during a considerable portion of the year by difficulties in obtaining supplies of materials. The Rogers Locomotive Works were operating as a third competitor, but their production was not made public. Since then the American Locomotive Co. has acquired the Rogers

Locomotive Works, and now advertises its capacity at 3,000 locomotives per annum. The Baldwin Locomotive Works are endeavoring to maintain a production of 50 locomotives per week. During March, 1905, they actually turned out 216 locomotives. It is therefore apparent that the combined capacity of these two concerns is approximately 5,500 locomotives per annum or sufficient to renew the entire locomotive stock of the country each eight years. Not only is their capacity sufficient for all the needs of our American railroads, but, as appears from the foregoing, there exists a surplus capacity of something like 1,600 locomotives per annum out of which to provide for increasing future demands, for exports to foreign countries and for sales to those buyers whose purchases do not figure in the statistics.

During periods of maximum demand, as during 1904 and the present year, 1905, prices of locomotives have been kept so low as to yield no more than a legitimate manufacturing profit. No law of nature is more inexorable than the commercial law of supply and demand. The fact that the capacity of the existing works has been ample for supplying the country during the years of most extreme demand, and that these unprecedented demands have not resulted in exorbitant prices, is the best possible proof that a proper balance now exists between demand and production, and that a further increase in the facilities of production could only result in depreciating the earnings of capital now legitimately invested in the industry of locomotive building. The past will repeat itself in the future. As the mileage and tonnage of our railroads grow, so will the established locomotive works grow. The wise conservatism which has directed them will continue to direct them. There can be no better proof of the wisdom of our railroads in abstaining, as a rule, from locomotive building in their own shops than the splendid support which has been given to the railroads by the locomotive works, and in the remarkable advances in locomotive construction, largely originating with locomotive builders, which have contributed to the low freight rates which are one of the essential causes of our national prosperity.

In the first quarter of this year the gross earnings of the Swiss State Railroads were 2.9 per cent. less, and their working expenses 4.8 per cent. more than last year. The Gotthard Railroad also, which is not yet in the state system, had a decrease of more than 20 per cent. in net earnings in that quarter.

Test of the Allfree-Hubbell Valve Gear.

Mr. B. P. Flory, Mechanical Engineer of the Central Railroad of New Jersey, recently made some interesting comparative tests on the company's Atlantic type engines Nos. 581 and 582. Engine 581 was equipped with the Allfree-Hubbell valve gear, and engine 582 was equipped with the Stephenson link motion and American balanced valves. The engines were identical with the exception of the valve gears, each having cylinders 19 in. x 26 in., with a working steam pressure of 200 lbs. and drivers 84¼ in. in diameter. The tests were made between Jersey City and Philadelphia; each engine hauled the same train and was in charge of the same engineman and fireman, the conditions being kept as near alike as possible on all of the tests. The data for engine No. 581 is shown in Table 1 and that for engine 582 is shown in Table 2. The comparison of the two engines based on the results as given in Tables 1 and 2 is shown in Table 3. The results of another test made on engine No. 582 when fitted with a 5⅛-in. nozzle is given in Table 4. On the first day of the test of engine 581 steam heat was used on the train all of the way between Jersey City and Philadelphia. The engine also had a new fire, which made the coal consumption more than the average. Most of the trips on engine 581

TABLE No. 1. ENGINE No. 581.—5-INCH NOZZLE.

Date.	No. of cars.	Weight—Of train, tons.	Weight—Coal, round trip.	Weight—Of water.	Pounds per ton-mile of—Coal.	Pounds per ton-mile of—Water.	Av'ge st'm pressure.	No. mins. blow off.	Time—Total running.	Time—For stops.	Time—Actual running.	Average speed, m.p.h.	Condition coal.	Condition fire.	Condition weather.	Temperature, air.	Steam-heat used.
								Jersey City to Philadelphia.									
April 3...	4	179.55	10,253	31,378	0.3192	2.076	192.9	49	2: 3:05	0:7:05	1:56:00	47.17	Good.	New fire.	Good	Not taken.	Yes.
April 4...	*4 & 5	180.65	8,313	30,828	.261	2.055	189.8	71	2:11:05	0:9:53	2: 1:12	44.66	"	Good.	"	60°	No.
April 5...	4	171.4	6,855	28,534	.222	2.006	190.7	36	2: 2:25	0:3:50	1:58:35	45.62	"	"	Rain	53°	No.
April 6...	4	170.5	7,462	33,397	.2423	2.192	191.2	N. T.	2: 3:25	0:3:47	1:59:38	45.23	"	"	Clear; stiff wind......	55°	No.
April 7...	4	171.4	7,948	31,013	.2443	1.955	189.8	48	2: 2:45	0:5:40	1:57:05	46.20	"	"	Clear; stiff wind	60°	No.
April 8...	4	170.5	7,950	31,745	.2577	2.226	189.0	93	2: 2:15	0:5:10	1:57:05	46.20	"	"	Heavy wind; snow	48°	No.
								Philadelphia to Jersey City.									
April 3...	4	175.75	10,253	35,324	0.3192	2.076	191.4	62	2: 2:25	0:5:08	1:57:17	46.12	Good.	New fire.	Good	Not taken.	No.
April 4...	4	170.5	8,313	34,498	.261	2.055	196.8	32	2: 3:10	0:7:15	1:55:55	47.20	"	Good.	"	60°	No.
April 5...	4	170.55	6,855	33,488	.222	2.006	187.3	47	2: 3:15	0:7:20	1:55:55	47.20	"	"	Rain.	53°	No.
April 6...	4	169.66	7,462	34,038	.2423	2.192	189.2	N. T.	2: 1:36	0:4:23	1:57:13	46.16	"	"	Stiff wind; clear.......	55°	No.
April 7...	4	187.8	7,948	32,479	.2443	1.955	184.9	43	2: 5:07	0:9:57	1:55:10	47.75	"	"	Stiff wind; clear.......	60°	No.
April 8...	4	170.5	7,950	36,884	.2577	2.226	189.4	59	2: 5:30	0:7:31	1 54:59	48.00	"	"	Heavy wind; snow....	48°	No.

*Jersey City to Trenton Junction, 4; Trenton Junction to Philadelphia, 5.
N. T.—Not taken.

TABLE No. 2. ENGINE No. 582—5-INCH NOZZLE.

								Jersey City to Philadelphia.									
April 13...	4	169.65	9,341	33,259	.304	2.53	188.5	57	2: 3:10	0:4:46	1:58:24	45.82	Fair.	Good.	Cloudy.	52°	No.
April 14...	4	170.55	8,095	34,545	.263	2.312	186.47	47	2: 3:20	0:4:15	1:59:05	45.54	Good.	"	Good	59°	No.
April 15...	4	174.3	9,880	36,199	.321	2.486	180.84	28	2: 6:30	0:3:15	2: 3:15	44.1	"	"	Clear; stiff wind.......	50°	Yes.
April 17...	4	179.55	10,766	42,814	.331	2.626	188.85	16	2:10:00	0:4:30	2: 5:30	43.21	"	"	Cold; strong wind.....	43°	Yes.
April 18...	4	170.5	9,726	37,853	.316	2.444	190.8	62	2: 2:30	0:2:47	1:59:43	45.81	"	"	Cool; cloudy	49°	Yes.
								Philadelphia to Jersey City.									
April 13...	4	169.65	9,341	44,468	.304	2.53	181.45	17	2: 2:45	0:4:52	1:57:53	46.02	Fair.	Good.	Cloudy	56½°	No.
April 14...	4	170.5	8,095	36,566	.263	2.312	191.91	61	2: 0:45	0:4:18	1:56:27	46.57	Good.	"	Good	62°	No.
April 15...	4	170.5	9,880	40,241	.321	2.486	184.17	28	2: 2:00	0:5:58	1:56:02	46.74	"	"	Clear; stiff wind.......	58°	No.
April 17...	4	179.55	10,766	42,446	.331	2.626	195.0	29	2: 0:45	0:3:15	1:57:30	46.12	"	"	Cold; strong wind	44½°	Yes.
April 18...	4	170.5	9,726	37,302	.316	2.444	187.66	46	2: 0:55	0:4:52	1:56:03	46.74	"	"	Cool; rain.	56°	Yes.

TABLE No. 3. AVERAGE RESULTS, ROUND TRIP.—BOTH ENGINES, 5-INCH NOZZLES.

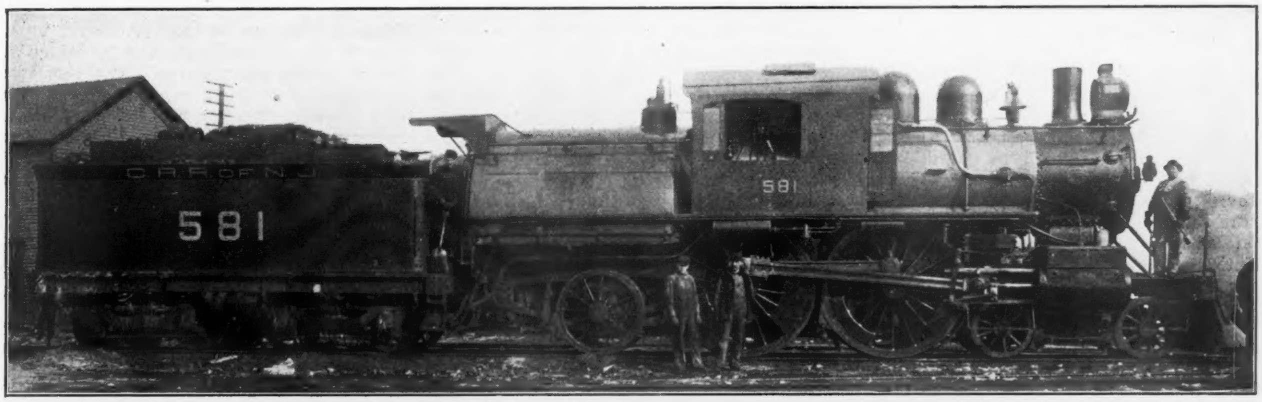
	Engine—No. 582.	Engine—No. 581.		Engine—No. 582.	Engine—No. 581.		Engine—No. 582.	Engine—No. 581.
Weight of train, tons.	172.52	174.05	Pounds of water per ton-mile.	2.48	2.085	Temperature of air	53°	55°
" coal, lbs	9,562	8,130	Average steam pressure, lbs..	187.57	190.2	Saving in coal, per cent.	..	16.1
" water, lbs.	77,139	65,601	No. of minutes blew off......	78	108	Saving in water, per cent. ...	..	15.92
Pounds coal per ton-mile....	.307	.2577	Average speed, m. p. h........	45.67	46.08			

TABLE No. 4. ENGINE No. 582—5⅛-INCH NOZZLE.

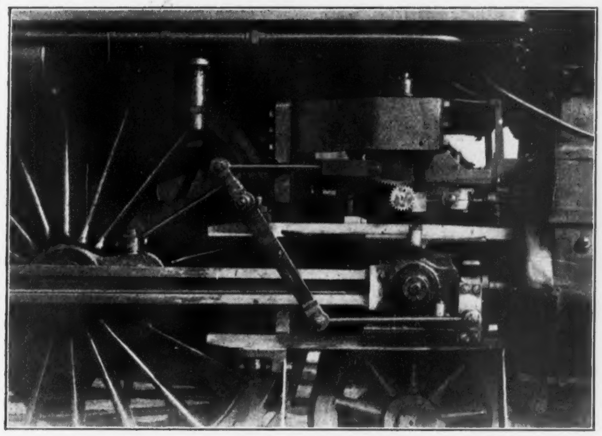
Date.	No. of cars.	Weight—Of train, tons.	Weight—Coal, round trip.	Weight—Of water.	Pounds per ton-mile of—Coal.	Pounds per ton-mile of—Water.	Av'ge st'm pressure.	No. mins. blew off.	Time—Total running.	Time—For stops.	Time—Actual running.	Average speed, m.p.h.	Condition coal.	Condition fire.	Condition weather.	Steam-heat used.
								Jersey City to Philadelphia.								
April 24...	4	170.8	9,561	36,750	.309	2.376	175.0	11	2: 3:00	0: 6:30	1:56:07	46.16	Fair.	Good.	Good.	No.
April 25...	4	168.6	8,265	35,831	.271	2.386	184.8	39	2:11:00	0:13:30	1:57:30	46.59	"	"	"	"
April 26...	4	179.5	7,679	35,831	.239	2.230	184.0	28	2: 3:00	0: 4:20	1:58:40	45.65	Good.	"	"	"
								Philadelphia to Jersey City.								
April 24...	4	170.5	9,561	36,566	.309	2.376	186.0	33	2: 3:00	0:8:10	1:54:50	46.80	Fair.	Good.	Good.	No.
April 25...	4	168.6	8,265	36,934	.271	2.386	178.2	31	2: 4:00	0:8:53	1:53:07	48.08	"	"	"	"
April 26...	4	179.5	7,679	36,566	.239	2.230	182.8	10	2: 1:30	0:7:39	1:53:39	47.83	Good.	"	"	"

TABLE No. 5. AVERAGE RESULTS—ROUND TRIP.

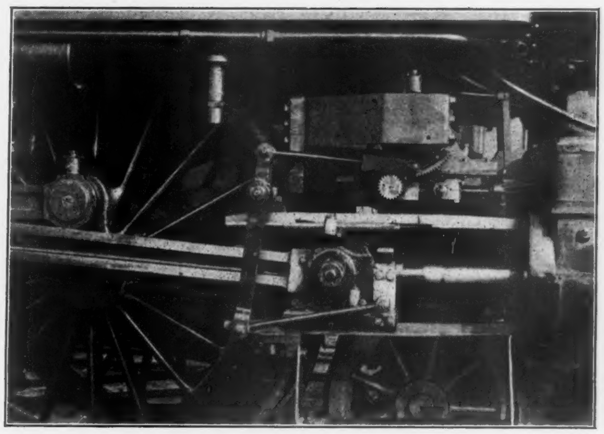
	Engine—No. 581. 5-in. nozzle.	Engine—No. 582, 5⅛-in. nozzle.		Engine—No. 581. 5-in. nozzle.	Engine—No. 582, 5⅛-in. nozzle.		Engine—No. 581. 5-in. nozzle.	Engine—No. 582, 5⅛-in. nozzle.
Weight of train, tons	173.35	172.9	Pounds water, per ton-mile..	2.087	2.3306	Average speed, m. p. h.......	45.97	47.01
" coal, lbs.	7,706	8,502	Average steam pressure.....	189.8	181.8	Saving in coal, per cent.....	10.00	.....
" water, lbs.	65,381	72,826	No. of minutes blew off.....	107	51.0	Saving in water, per cent...	10.45	.....
Pounds coal, per ton-mile....	.2455	.273						



Locomotive No. 581, C. R. R. of N. J., Fitted With Allfree-Hubbell Valve Gear.

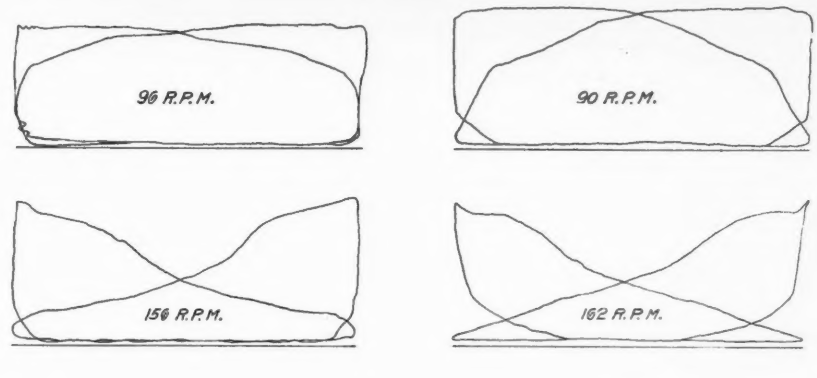


Full Stroke.



Half Stroke.

Allfree-Hubbell Valve Gear as Fitted to Locomotive 581.



Locomotive 581. *Locomotive 582.*

Comparison of Indicator Diagrams from Locomotives 581 and 582—C. R. R. of N. J.

were made under good weather conditions. On the tests of engine 582, however, the last three days were cold, with strong winds, and steam heat was used most of the time. It seemed hardly fair to compare these tests with those of engine 581, and so a second series of tests were made on engine 582, and at the same time the exhaust nozzle was increased to 5⅛ in. It was found during the first tests that engine 582 worked its fire harder than engine 581, and this was the reason for increasing the size of the nozzle. In Table 5 are shown the comparative results of the tests of engine 581, with the first day's run left out, on account of using steam heat and having a new fire, and of engine 582 fitted with a 5⅛-in. nozzle. The saving in per cent. of coal and water was figured from the pounds of coal and water per ton mile.

It is very remarkable that any design of valve gear could produce as high a saving in percentage of water and coal, 10.45 per cent. to 15.92 per cent. and 10 per cent. to 16.1 per cent. respectively, over a well-designed Stephenson link motion running in good condition as is shown in Tables 3 and 5. Some interesting comparative results might be obtained if the engines were again tested under reversed conditions, that is, if engine 582 was to be fitted with the Allfree-Hubbell gear and engine 581 was fitted with the Stephenson link motion. The results of such a test would show conclusively whether the apparent efficiency of engine 581 as fitted with the Allfree gear was entirely due to the valve gear or whether from other causes. For the accompanying photographs and for the results of the tests we are indebted to B. P. Flory, M.E., and to W. McIntosh, Supt. of M. P. of the Central Railroad of New Jersey.

Consolidation Locomotive for the N. Y. Central, with Walschaert Gear.

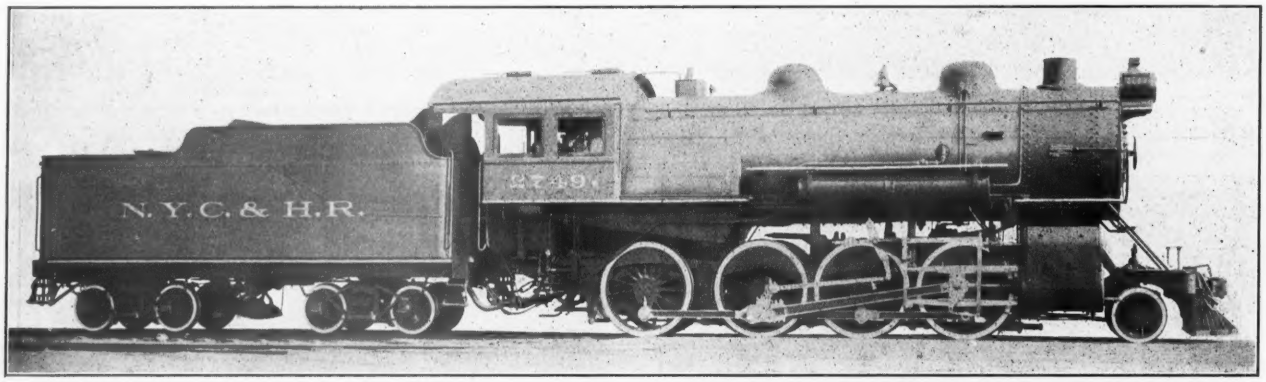
In the opinion of many engineers the American locomotive is on the verge of a revolution in the details of its construction. The rapid growth that the four-cylinder balanced compound has made in public favor, coupled with the convenient use of the Walschaert gear in connection with it, has led to the belief that the value of this gear will soon be widely recognized and as widely adopted by American railroads. Its advantages lie in the avoidance of the use of heavy eccentrics and straps, the lightness and accessibility of all of its parts; the freedom from disorders and the maintenance of a constant lead for all points of cut-off. In spite of these advantages the Stephenson link has been so thoroughly intrenched in the practice of the United States that no other gear has received more than spasmodic and desultory attention. The use of the Walschaert gear on the big Mallet compound locomotive for the Baltimore & Ohio Railroad has attracted attention to it while its satisfactory operation has led to a serious trial in other places.

Among the engines recently built with the Walschaert gear is a heavy consolidation for the New York Central, the general appearance of which is shown by the reproduction of the photograph. The engine is fitted with piston valves in connection with cylinders of rather exceptional size, they being 23 in. in diameter with a piston stroke of 32 in. The boiler used must necessarily be of large dimensions and is shown in longitudinal section. The bottom of the firebox is raised well above the top of the rear drivers and consequently above the frames. It is carried by a special attachment to the mud ring. The front and back cross bars, as shown in the engraving, have a lip projecting downward which is bolted to a carrying plate ⅝ in. thick, that extends the whole width between the frames and performs the threefold function of carrying the firebox, acting as an expansion plate by buckling with the increased length of the boiler when under steam and serving as a cross brace for the frames. The firebox, which is more than 9 ft. long and 6¼ ft. wide, is fitted with a brick arch carried on water tubes expanded into the tube and back sheets. The arch itself only covers about one-half the length of the box and has a wide opening between it and the crownsheet. The width of the firebox has made it seem advisable to use two 15-in. round doors, which are only 15 in. above the mud ring. The slope of the firebox and the grates to the front makes it possible for the fireman to place the coal where it is desired. The tubes are spaced fairly well apart, there being ¾ in. between the outsides. The dome is a striking example of what designers have been driven to by the increasing height and size of the locomotive boiler. It is not many years ago since a dome 15 in. high would have been considered an absurdity, and would not have been used on account of the probable moisture of the steam that would have thus been delivered to the cylinders. No difficulty, however, seems to be experienced from the use of such a dome in practice. The water spaces, in the firebox legs, are of ample width to insure a proper circulation. At the sides the mud ring is 4½ in. wide and the space widens to 6½ in. at the bottom of the curve of the crown, with even a greater increase at the throat. The shell is sextuple riveted on the longitudinal seams and the sheets are $^{13}/_{16}$ in. thick.

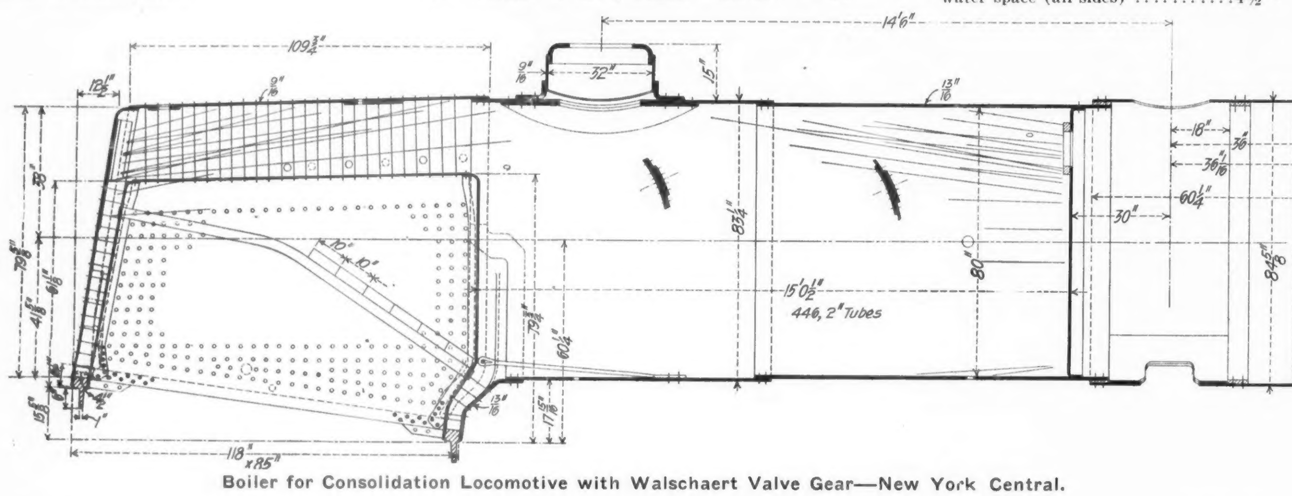
The arrangement of the Walschaert gear is shown by the side elevation of the engine and the plan of the gear itself. Probably for constructional reasons, the radius bar projects well back of the link where it passes through a sleeve, A, that is carried by the arm of the lifting shaft, and by which the bar is raised and lowered. The link itself is supported on trunnions between the arms of a bracket extending back from the motion plate, and is of the box type with the block between the two parts.

The following is the list of the general dimensions:

Cylinder diameter	23 in.
Piston stroke	32 in.
Tractive power	45,700 lbs.
Wheel base, driving wheel	17 ft. 6 in.
" total	26 ft. 5 in.
" total engine and tender	60 ft. 6½ in.
Weight on drivers	197,500 lbs.
" total of engine	221,500 "
" total of engine and tender	366,700 "
Heating surface, tubes	3,489.47 sq. ft.
" " firebox	185.64 "
" " arch tubes	27.41 "
" " total	3,702.52 "
Grate area	56.25 "
Axle, main drvg. journals	10 in. diam., 12 in. long
" other drvg. journals	9½ " " 12 " "
" truck journals	6 " " 12 " "
" tender journals	5½ " " 10 " "
Boiler, type	Straight top
Boiler, outside diam. first ring	81⅝ in.
Firebox, length	108 1/16 "
" width	75¼ "
" crownsheet thickness	⅜ "
" tube sheet	9/16 "
" side and back sheets, thickness	⅜ "
" water space (all sides)	4½ "
Crown sheet support	Radial stays
Steam pressure	200 lbs.
Tubes, material	Charcoal iron
" diameter	2-in.
" length	15 ft. ½ in.
Exhaust nozzle, diameter	5¾ "
Smokestack diameter	20 "
Tank, water capacity	7,500 gals.
Tank, coal capacity	12 tons
Valves, type	Piston
" gear	Walschaert
" travel	6 in.
" steam lap	⅞ "
" exhaust lap	0
" lead in full stroke	0
Wheels diameter of driving	63 in.
Wheels, diameter of truck	33 "
Ratio, heating surface in sq. in. to cylinder volume in cu. ft.	481.3 to 1
Tractive weight in lbs. to heating surface in sq. ft.	53.34 to 1
Tractive weight to tractive effort	4.32 to 1



Simple Consolidation (2-8-0) Locomotive with Walschaert Valve Gear—New York Central.

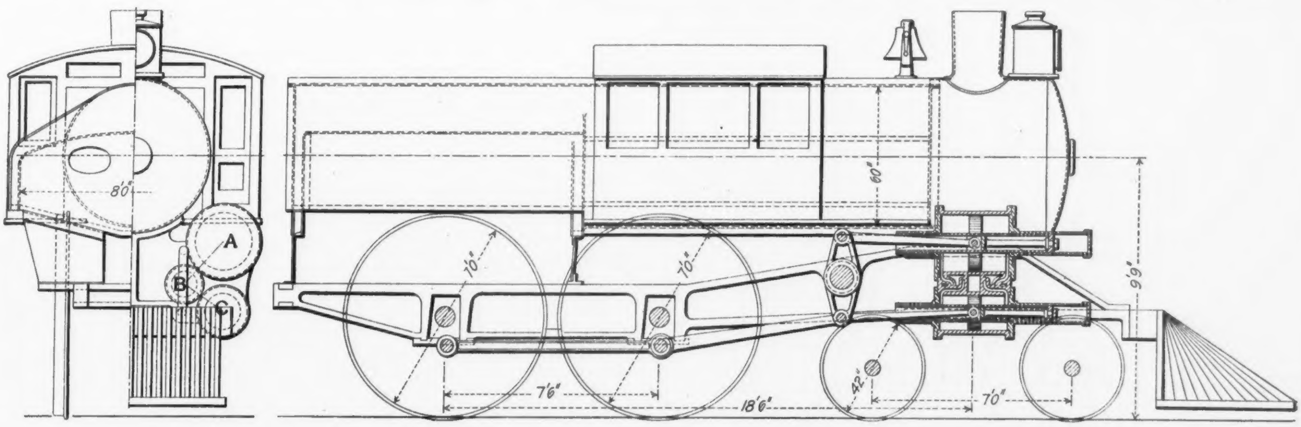


Boiler for Consolidation Locomotive with Walschaert Valve Gear—New York Central.

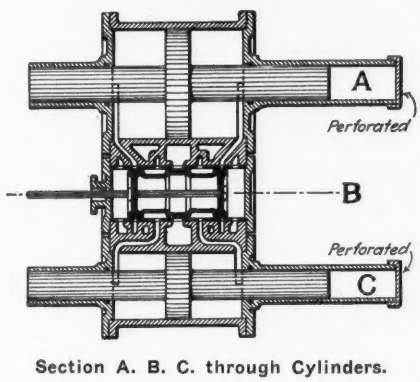
A New Design for a Four-Cylinder Balanced Compound Locomotive.

BY SAMUEL F. PRINCE.

Since 1889, the writer has devoted much time to the study of locomotive counterbalancing with special reference to embodying compounding with perfect balance of the reciprocating parts. While mechanical engi-

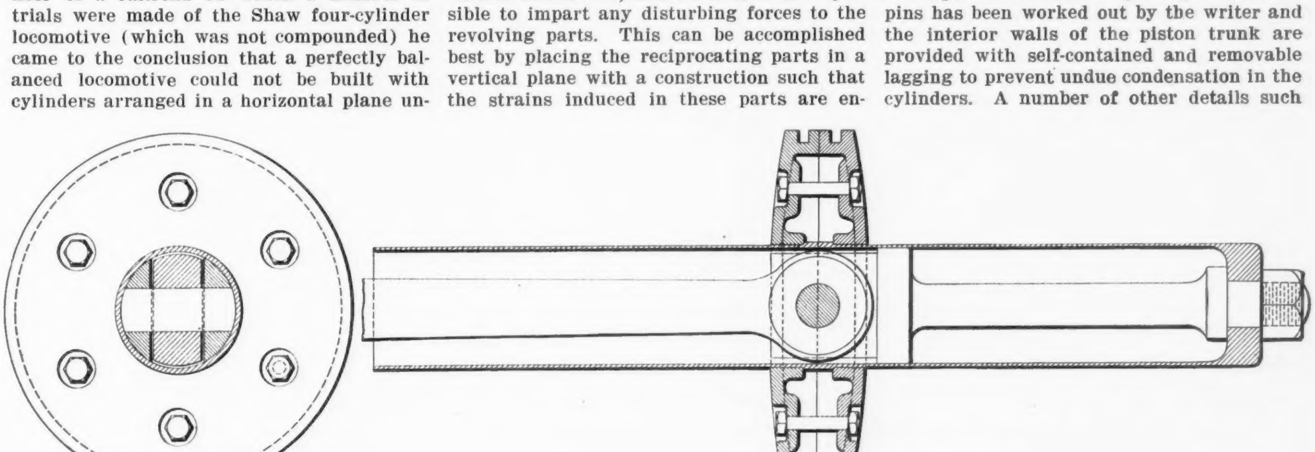


Application of Prince's Four-Cylinder Balanced System to American (4-4-0) Type Locomotive.



Section A. B. C. through Cylinders.

neer of a railroad on which a number of trials were made of the Shaw four-cylinder locomotive (which was not compounded) he came to the conclusion that a perfectly balanced locomotive could not be built with cylinders arranged in a horizontal plane un-



Detail of Trunk Pistons.

less a cranked axle or some other construction, mechanically unsatisfactory, was used. Certain disturbing forces are set up by the reciprocating parts induced by the angularity of the connecting rod and the moments of these forces extend laterally through the revolving parts of the engine on one side to the revolving parts of the engine on the other side. A locomotive practically consists of two distinct mechanisms, one carried directly on the rails, consisting of the revolving parts, and the other carried on the springs, the latter being free to move vertically on the former within the limits of the pedestal clearance. It will thus be seen that all the forces originating within the cylinders are not self-contained when considered in relation to the locomotive as a complete structure; and hence with a finite length of connecting rods, all angular stresses due to the direction of forces in the reciprocating parts must produce vertical stresses in the driving wheels which manifest themselves as rail disturbances. In the absence of any published data of the tests made with four-cylinder balanced compounds on the Pennsylvania Railroad's testing plant at the Louisiana Purchase Exposition last year, it is difficult to predict the extent of these disturbances. A composite diagram showing the synchronous opposite rail pressures of the main pair of driving wheels through which the balancing of the reciprocating parts is effected would be interesting and instructive.

In order to meet the conditions outlined above and to secure perfect balancing, the reciprocating parts must be so related to each other that they are balanced entirely within themselves, and so that it is impossible to impart any disturbing forces to the revolving parts. This can be accomplished best by placing the reciprocating parts in a vertical plane with a construction such that the strains induced in these parts are entirely self-contained. In the design shown in the accompanying drawings, which design has been patented by the writer, such a construction has been followed.

By reference to the drawings it will be seen that the construction consists essentially of two trunk engines on each side of the locomotive, one above the other. The connecting rods of the two engines are attached to the ends of a rocker mounted on a suitable shaft so that they balance each other perfectly since the weights of the reciprocating parts are exactly equal. Additional weight is put in the upper end of the rocker arm to counterbalance the weight of the front end of the main rod. The general features of the design are clearly shown in the drawings so that an extended description is unnecessary. It might be said, however, that the shaft carrying the rocker arms extends across the engine under the boiler from side to side and also forms a tie for the engine frames. The piston trunks are of extra heavy seamless tubing, reduced externally to the necessary diameter for requisite strength, leaving an enlargement or rim at the center as a seat for the piston heads which are made in two parts, bolted together. The forward end of the trunk has a head welded in, to which is attached the extension which carries the wrist pin for the trunk pitman. When in extreme forward position, the nut securing the extension is accessible so that the pitman and extension can be removed by withdrawing from the crank end. The extension barrels and piston trunks have very large wearing surfaces which would insure long service before it would be necessary to bush the extension barrels to take up wear. A simple method of oiling the pitman wrist pins has been worked out by the writer and the interior walls of the piston trunk are provided with self-contained and removable lagging to prevent undue condensation in the cylinders. A number of other details such as the main frame construction, rocker shaft bearings, etc., have been designed but are not shown on the sketch. The steam ports and piston valves are arranged for central admission.

The aim in working out the design here shown has been to combine perfect balance, accessibility of all parts and a construction tending to reduce the cost of maintenance in contra-distinction to the prevailing types of four-cylinder compounds in which the two

inside engines are buried underneath the boiler and saddle and are quite inaccessible for cleaning or repairs.

Shop Kinks from the Spencer Shops of Southern Railway.

The accompanying illustrations show a few of the many ingenious labor-saving devices designed and in use in the Spencer shops of the Southern Railway. Fig. 1 shows a tool for cutting flue holes. The shank "A" and the tool holder "B" are forged in one piece. A half-inch collar "C" is shrunk on B as shown, and the tools, which are of $^5/_{16}$-in. x ¾-in. Novo steel, are placed in the slots "D," where they are securely fastened by means of the set screws "E" and the wedges "F." They are then ground to the proper shape by means of emery wheels. The outside of the tools are ground in a

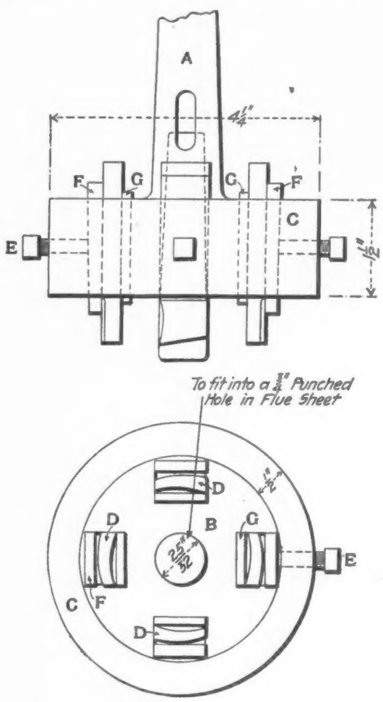


Fig. 1—Special Tool for Cutting Flue-Holes.

universal grinding machine, the tool holder being placed on centers. The inside of the tools are ground by hand on a small emery wheel. The gibbs "G" are made in sets of four, and each set has a different thickness. They are placed in the holder as shown, and are used for adjusting the tools for cutting different size holes. Mr. E. L. McAllister, foreman of the tool room, designed this tool, and he claims that it will cut a flue hole in 1 min. and 40 sec. and that as many as 116 holes have been cut without regrinding the cutters.

In Fig. 2 is shown a tool for simultaneously machining the inside and outside of a cylinder packing ring casting. This tool can

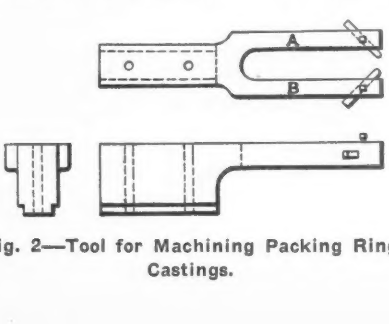


Fig. 2—Tool for Machining Packing Ring Castings.

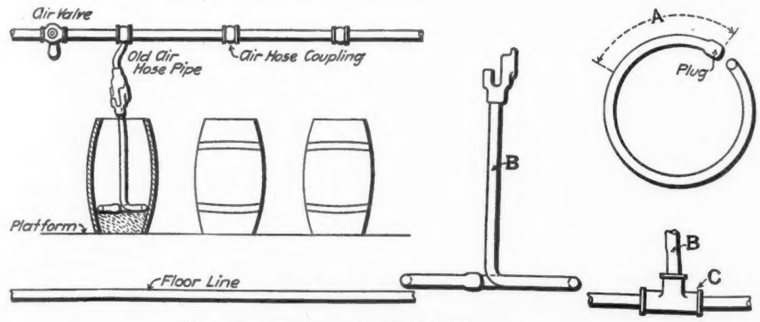


Fig. 3—Pneumatic Paint Mixer.

be used to advantage on either a lathe or a single head boring machine. The slot can be of any desired length provided that the two arms a and b are made stiff enough to withstand the strain put upon the cutting tools. The space between the arms should be wide enough to allow ample clearance for the admission of the widest packing rings. The base of the tool is formed so that it will fit into the face of the tool-post block, to which it is secured by means of two bolts.

Fig. 3 shows a pneumatic paint mixer. It is made of ½-in. iron pipe having attached to its upper end an air hose coupling. The lower portion of the pipe is bent into a

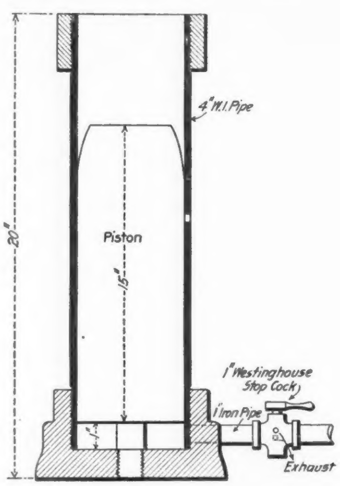


Fig. 4—Pneumatic Hammer for Removing Frame-Bolts.

circle which is a trifle smaller in diameter than the inside of the bottom of the barrel. A number of $^1/_{16}$-in. holes spaced 2 in. centers are drilled in the circular portion of the pipe. These holes allow the air to pass into the barrel and agitate the paint, by means of which it becomes thoroughly mixed. This device has been in use for a long time and has given perfect satisfaction. The only trouble experienced is that the holes in the pipe at "A" become clogged up. This is probably due to the air having spent its force before reaching this point by escaping through the small holes nearest the main air connection. By connecting the portion "B" of the mixer to the ring by a T as shown at "C" this objection would no doubt be overcome, as the air would circulate through the ring in both directions. The arrangement of the main air line and the method of connecting the device for use is shown in the illustration. The mixer is connected to an old air hose, which, in turn, is connected to the main air line by means of an air hose coupling. As many air hose

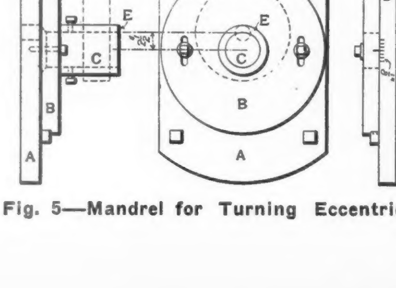


Fig. 5—Mandrel for Turning Eccentrics.

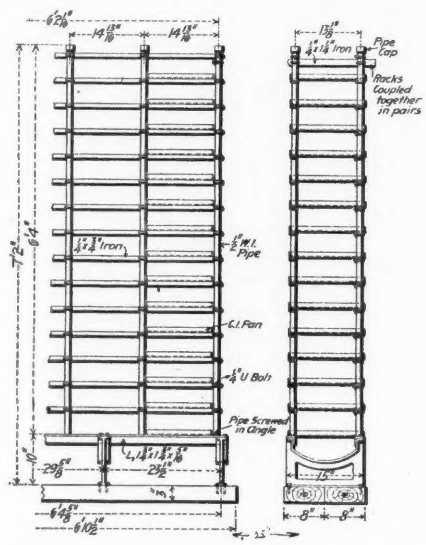


Fig. 6—A Simple Design of Shop-Tool Rack.

couplings as desired can be attached to the main air line, but at the Spencer shops one is placed over each barrel, as shown.

The pneumatic hammer shown in Fig. 4 is used for driving out locomotive frame bolts. The air cylinder is made of a 4-in. wrought iron pipe screwed into a wrought iron base. To prevent the top of the cylinder from being dented, a collar is screwed on it. The plunger is of wrought iron and is 15 in. long. A lug 1 in. in diameter is screwed to the bottom of the cylinder. This lug extends into the cylinder for about 1 in. and pre-

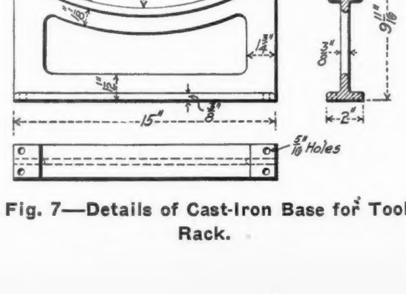


Fig. 7—Details of Cast-Iron Base for Tool Rack.

vents the plunger from striking the bottom of the cylinder, and it also provides an air chamber under the plunger. A 1 in. iron pipe fitted with a 1 in. Westinghouse stop cock passes through the base and into the air chamber, as shown. At the end of this pipe is fitted a 1 in. Westinghouse air coupling, by means of which the apparatus is connected to the main air line by an air hose and coupling. The device is placed in position under the bolt and a quick on and off movement of the air valve causes the piston to shoot up and strike the bolt. A vent hole in the side of the cylinder allows the air to escape after the piston has delivered its blow. It is claimed that with this device the most stubborn bolt can be removed.

An adjustable mandrel for turning eccentrics is shown in Fig. 5. It consists of the base plate "A," the adjustable plate "B" and the mandrel "C." The hole d in the base plate "A" fits into a special lathe center and the base plate is secured to the face plate of the lathe by bolts. The adjustable plate "B," to which is fixed the mandrel "C," is secured to the base plate by bolts which pass through slotted holes, as shown. The plate "B" has a center line marked on its upper surface at D which is set to a mark on the base plate "A" for a 5-in. throw. Graduations placed ⅛ in. apart are placed on both sides of this mark on the base plate "A," as shown at "D." By means of these graduations the mandrel may be set to give any desired throw to the eccentric. Bushings such as shown at "E" are made to fit the different sizes of eccentrics, and they are secured to the main mandrel by set screws.

A simple and substantial tool rack used at the Spencer shops is shown in Fig. 6. The cast-iron bases which are shown in detail in Fig. 7 are secured by lag screws to two 8-in. x 3-in. planks and to the top of the bases 1¾-in. x 1¾-in. x $5/16$-in. angles are bolted, as shown. Into the top of the angles ½-in. iron pipes are screwed; these are placed at $14\frac{3}{16}$-in. centers. The supports for the cast-iron pans are made of ¼-in. x ¾-in. iron rods. These are secured to the pipes by ¼-in. U bolts as shown. Each rack is about 15 in. wide and can be made as long as desired. As a rule the racks are placed back to back and are coupled together in pairs by a ¼-in. x 1¼-in. iron bar as indicated in the illustration.

Counterbalance for Balanced Compound Locomotives.

BY LAWFORD H. FRY.

The accompanying photograph, Fig. 1, shows a pair of wheels for a recent four-cylinder balanced compound Atlantic type locomotive. It will be noticed that the counterbalance is placed so that the center line makes a considerable angle with the radius on which the crank-pin is placed. This position of the counterbalance appears at first sight to be somewhat unexpected, but a simple calculation shows the reason for this position of the balance.

Fig. 1.

The calculation necessary to determine the proper position of the counterbalance is illustrated by Fig. 2. The weights and dimensions shown in this figure are not taken from an actual example, but are chosen to give results in round figures. It is assumed that the unbalanced part of the crank axle and the end of the inside main rod weigh 1,500 lbs., and that the center line of the main rod comes 15 in. from the center line of the nearest counterbalance, and the distance between the center lines of the two counterbalances to be 60 in. It is further assumed that the weight of the outside wrist pin hub, wrist pin and outside rods, is 600 lbs., and that the center of gravity of these parts is 16 in. outside the center line of the nearest counterbalance.

To completely balance the outside parts, which weigh 600 lbs., it is necessary to put the weight C_1 of 760 lbs. in the left wheel, and the weight C_2 of 160 lbs. in the right wheel. These weights are determined by the calculation shown in Fig. 2. The weight C_1 in the left-hand wheel is made of such a size that if moments are taken about the center line of the other counterbalance, the moment of C_1 will be equal to the moment of the original weight to be counterbalanced. C_2 is then made equal to the difference between C_1 and the original weights. This gives two counterweights, which stand in such relation to the original weight to be balanced, that in any plane through the axle there is neither an unbalanced throw, nor a couple tending to turn the axle.

The inside weight of 1,500 lbs. is similarly balanced by a counterweight C_3 of 1,125 lbs. in the left-hand wheel, and C_4 of 375 lbs. in the right-hand wheel. This gives four counterweights, which completely balance the inside and outside parts on the left-hand side of the locomotive. Of these counterweights C_1 and C_3 in the left-hand wheel are on opposite sides of the axle, and therefore tend to counteract each other.

It is therefore only necessary to put into the left-hand wheel the weight K_1, which is the difference between C_3 and C_1. The weight required in the left-hand wheel is represented in the cut by the shaded segment marked $K_1 = 365$ lbs. In the right-hand wheel the counterweights C_2 and C_4 come on the same side of the axle and the necessary counterweight is represented by the shaded segment $K_2 = 535$ lbs., which is the sum of the two original counterweights.

It now remains to take care of the revolving parts on the right-hand side of the locomotive in a similar manner. These parts stand at right angles to the parts on the left-hand side and the counterweights necessary to take care of them are represented by the unshaded segments, the chords of which run vertically in the cut.

This gives in each wheel counterweights standing at right angles to each other. In practice the two weights are combined and the resultant weight stands at an angle to the radius through the crank pin. This resultant weight is obtained by applying the parallelogram of forces.

The above calculations are carried out considering all weights as revolving at crank pin distance, and the weights given for the counterbalances are also assumed to act at the circumference at the crank pin circle. In calculating an actual example it would be necessary to reduce the weights thus obtained to their equivalent weights at the circumference of the wheel.

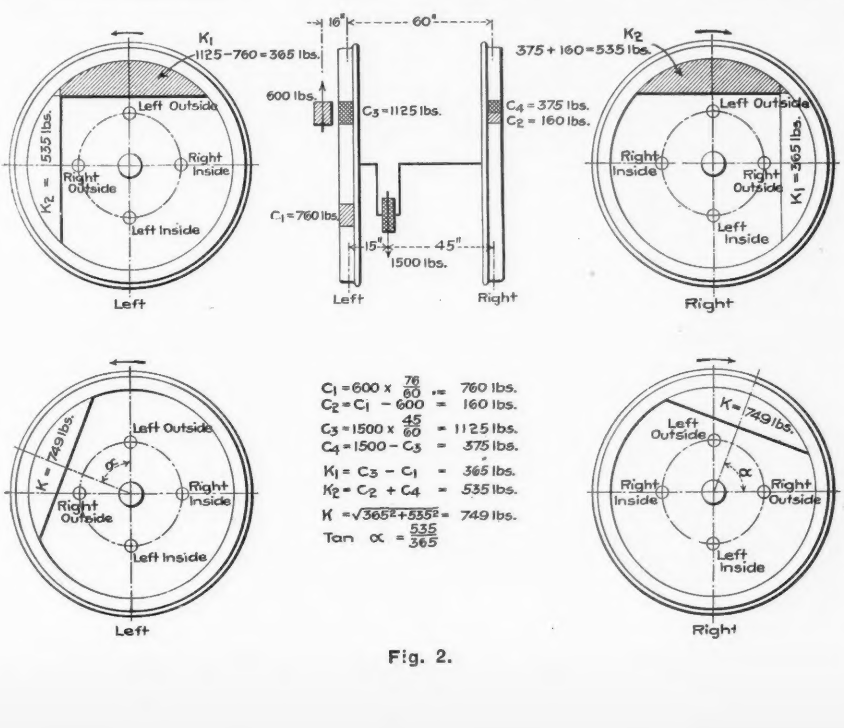


Fig. 2.

Convention of Master Boiler Makers.

In speaking before the convention of Master Boiler Makers at Buffalo, Mr. F. W. Williams, Master Mechanic of the Delaware, Lackawanna & Western, gave some data regarding the proper methods of piping repair pits for air. He said: The shop should be piped with pipe large enough to maintain maximum pressure at the taps, laid along the front or back end of the pits. A sufficient number of taps should be taken off from the pipe and laid to each end of the pits to accommodate all workmen requiring the use of air. The pressure should be not less than 120 lbs. at the tap. The taps from the supply pipe, if more than 10 ft. long, should be ¾-in. pipe. The hose, if more than 20 ft. long, should be ¾-in. instead of the ½-in. hose most generally used. The hose fittings should all be interchangeable and very securely fastened to the hose. In touching upon the subject of boiler repairs he held that a considerable amount of patching on high-pressure boiler fireboxes is bad practice. A small amount is permissible. The more the patching the greater the number of engine failures, especially in bad water districts. Weak and leaky tubes are other very bad and irritating boiler diseases, and it is always expensive to maintain boiler tubes in good condition. In good water districts it is an easy and simple matter; on the other hand, however, it is very difficult to keep the tubes tight in boilers using very bad water. In bad water sections, wash the boilers frequently; use blow-off cocks frequently at terminals. Do not make a practice of plugging a number of the weakest tubes and attempt to keep the locomotive in service in that crippled condition. Do a small amount of plugging. Take few chances on weak or wornout tubes. Hold the locomotive in and reset as many as is necessary to put the boiler in condition to give 100 per cent. service every trip it makes and it will earn the company far more money than it can possibly do under any other system.

As to the value of water purification: on a grade 70 miles east of Buffalo where from six to eight pusher engines are used the year around, and where the water was the poorest, there was a serious amount of trouble with leaky boilers, and especially with the tubes. On account of the continued trouble from leaking, the engines were out of service a great deal of the time. It was necessary to wash the boilers twice every week. In November, 1902, a water purifying plant was put in there and excellent results have been obtained from the use of the treated water.

Referring to the records, it was found that a certain engine wore out 307 tubes between Jan. 1, 1902, and Jan. 1, 1903, and that during that time it made 31,442 miles, an average of 103 miles to the life of each tube. The engine was taken to the shop Jan. 1, 1903, and given a full set of tubes (207) and the test on the treated water was conducted from January, 1903, to Oct. 17, 1903. During the 10½ months the engine made 39,044 miles, or 188 miles per tube, and the tubes were still in fair condition up to that time, so that there was a gain of at least 85 miles, or 82.5 per cent. per tube.

The records of other engines show equally good results. An examination of the interior of the boilers show that it is a fair estimate that there is about 75 per cent. less sediment on the tubes and boiler shell than was formerly found in the same boiler for a similar period of service. It is also considered fair to estimate that there was a saving of at least 5 per cent. in fuel, due to less sediment in the water.

They have installed on that division a sufficient number of water softening plants to give their locomotives good boiler water, and claim to have reduced the engine failures due to boiler leaking as follows:

	1902	1903
Leaky tubes	463	330
" fireboxes	31	26
" arch tubes	6	2
Totals	500	358

or a reduction, 1903 compared with 1902:

Leaky tubes	30%	Leaky arch tubes	66%
Leaky fireboxes	13%		

A big reduction was shown in boiler work required; the boiler shop force was materially reduced, and the results obtained from treated water were very satisfactory.

MAINTENANCE OF FLUES.

In the report on this subject it was held that standard beading tools should be made and used and brought up to correspond with the templet when they become worn and that roundhouse men should not be allowed to use the pean of a hammer in place of proper tools to stop leaking flues, as this is severe on the beads and will shorten the life of the flue considerably. Then, by welding the safe ends on the opposite ends of the tube, first using 5-in. pieces then 7-in and finally 8-in. tubes can be welded seven times without having more than three welds. In swaging flues for the copper ferrule the workman should be governed by the size of the hole in the tube sheet, since in bad water districts the flue holes become larger as the result of the frequent working of the tubes. When the holes become $^1/_{32}$-in. out of round they should be reamed back to true.

The copper ferrule should not be over $^1/_{32}$-in. wider than the flue sheet is thick. Further, it is probable that tubes are usually spaced very much too close together to give the water proper circulation, and the life of the flue while in service would greatly be increased if the water space would be increased to ⅞ in., especially where there are 300 or more flues in the boiler.

Among the causes that were given for leaky tubes were: too little space between the grates and the bottom tubes; failure on the part of the fireman to keep a good fire next the tube sheet; the use of the blower when knocking out the fire, thus sending cold air through the tubes while they are hot, and causing a sudden contraction of a part of them; putting water in the boiler after the fire had been dropped; the blowing out of steam and water at the same time, thus allowing the water line to fall below the top of the tubes when there is still a pressure on the boiler, and neglect to keep the boiler properly washed.

A method of caring for tubes recommended was to let the engine run about 1,000 miles, and then go over them, expanding with a sectional expander and beading if necessary but not using rollers, as that soon makes the tubes thin in the sheet and destroys them.

DOUBLE FIREBOX DOORS.

On this topic there was a unanimity of opinion that the double door is an objectionable feature of boiler construction, as it is not only expensive to construct and maintain, in that it tends to promote the cracking of the sheets, but the two doors are particularly inconvenient for the firemen.

METHOD OF REPAIRING LEAKY FIREBOX SEAMS.

In case of sheets separating at the caulking edge, a fine caulking tool should not be used; it acts as a wedge and aids in separating the plates. A large fuller can be used with good effect by holding same at an angle of about 45 deg. and laying up the edge of the lap while it is being caulked. Loose rivets should be replaced with a patch bolt or thread plug. Fire cracks should be chipped out so as to allow the rivet, or patch-bolt to overlap and then joint caulking edge with rivet head. All leaky seams should be re-riveted when practicable. If the fire cracks are numerous and the seams in bad condition then the entire seam, or fractured part, should be removed and replaced with a patch about 6 in. wide.

REMOVAL OF SCALE FROM RADIAL STAYS.

One of the best methods is the preventative one of having a good reliable boiler washer. In one case where the stays were in bad condition from a hard lime scale, crude oil was used. About two quarts were put in every time the boiler was washed out. As it was found that this was loosening the scale the amount was increased until about two gallons were used. This loosened the scale so that it could be washed out afterwards. Then when the washing had been done, oil would be put in the empty boiler, which would be filled, and the oil would rise in the water and spread to every part of the interior of the boiler.

Another method used when the sheet began to bag down between the crown-bar bolts, is to heat the bagged sheet to a red heat by means of a charcoal hopper with a ¼-in. air pipe attached, driving up the sheet, thus loosening the scale, and, by means of the ¼-in. pipe, blowing it out from under the bars and off the crown sheet where it was impossible to wash it out.

A mechanical method employed was to strip the wagon top so that every bolt was accessible, then, holding each bolt with a sledge and using a long stroke pneumatic hammer on the outside and a short stroke hammer on the inside, the scale was jarred loose and afterwards washed out.

Barclay's Printing Telegraph.*

The Western Union Telegraph Company has recently installed and put in practical operation a method of page printing by telegraph devised by Mr. John C. Barclay, Assistant General Manager and Electrical Engineer of the company, which greatly simplifies the operation of automatic telegraphy and gives strong promise of having at last solved the hard problem of producing a satisfactory and really practical typewriter page printing device.

That Mr. Barclay's invention is really practical is proved by the fact that since the day it was installed between New York and Buffalo six months ago, the circuit has handled daily all the business formerly taken care of by the automatic system it was substituted for, with a margin of time to spare, and delivered the copies in type and in a form as neat and finished as any turned out by the most expert typewriter.

Among the many other advantages in Mr. Barclay's method is that of being able to take manifold copies of press and other matter. Incoming messages and press matter are printed, ready for delivery, on ordinary telegraph blank forms in the same manner as if copied by typewriter operators on Morse circuits.

In order to help the reader to follow a

*For most of this description and for the illustration, Fig. 1, we are indebted to an article by Willis H. Jones, in the *Telegraph Age*. Mr. Jones refers to some parts of the apparatus with extreme brevity, making the description somewhat unsatisfactory; but this is due probably to the restrictions imposed by the fact that some of Mr. Barclay's patents are not yet completed. The present description does, however, give a fair idea of the principle on which the machine works and of its chief parts. To read the article easily it is desirable to commit to memory the numbers of the principal relays, as follows:
Polar 74.
Separator 78.
Escapement Actuator 79.
Primary polar selecting relays, 105, etc.
Synchronizer 98.
Secondary selecting relays 112, etc.
Spacing magnet 9.
Carriage-return magnet 49.
Paper-feed magnet 59.
Type-shift magnet. 73.
Restoring relay 123.
Spacing cut out 141.

detailed description of this apparatus it is proper to give a brief preliminary outline of its general features and principle of operation.

The receiving apparatus for the main line consists of but one instrument, a differentially wound polarized relay, the front and back contact points of which control, alternately, quired for spacing, shifting the carriage and other demands.

The entire operation of the typewriter is accomplished by means of relays and magnets in local circuits, hence the instruments are not only immuned from weather and other extraneous influences, but when once properly adjusted they are permanently adposition by rotating the wheel in methodically measured degrees, aided at times by giving it an axial motion. The rotation of the wheel and the striking of the blow necessary for making an impression is effected by power derived from the driving shaft through the agency of a clutch.

A detailed description of the mechanism

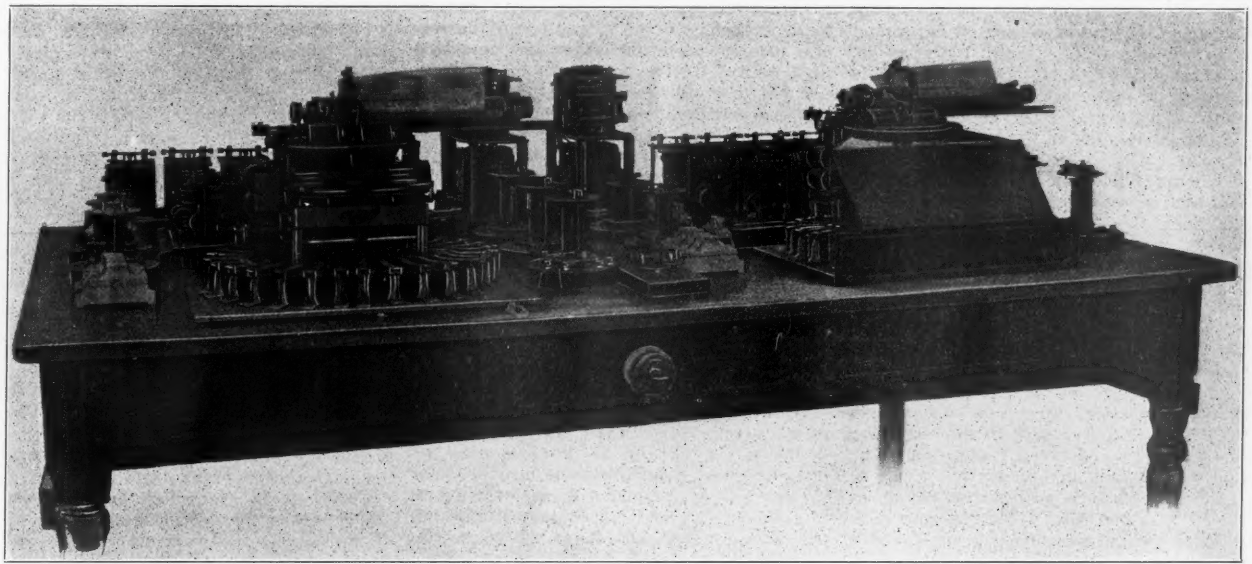


Fig. 2—Barclay's Printing Telegraph Machine.

two local circuits containing apparatus, in one of which an instrument in turn controls a set of magnets possessing peculiarly constructed armature levers through which, singly or in combination, a path or circuit may be constructed to any desired key or letter magnet of the typewriter, according to the positions the said levers are given. The number of possible combinations in the positions of these circuit-creating levers has been found amply sufficient to provide paths for the local current to an individual magnet for all the letters, figures, and necessary punctuation marks of a standard typewriter, as well as what additional magnets are rejusted and require practically no further attention in that line.

Mr. Barclay's system is also particularly fortunate in not requiring the synchronizing of the home with the distant relay. That factor is entirely eliminated.

The typewriter used in this system is a Blickensderfer electric machine with such parts omitted as are not necessary in Mr. Barclay's arrangement. The power used in its operation is derived from a constantly driven motor fixed within the casing.

The typewheel has on its periphery all the necessary letters and characters required in printing, any one of which is brought into

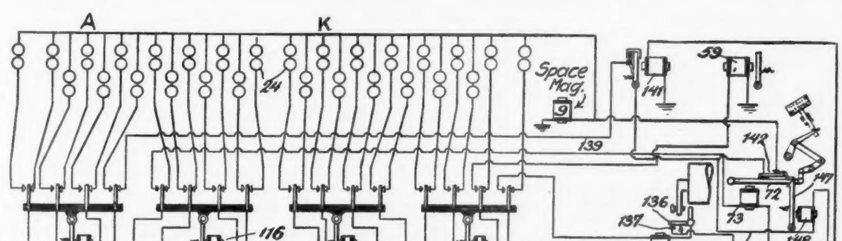


Fig. 1—Circuits for Receiving Apparatus of Barclay's Printing Telegraph.

The armatures of all the secondary selecting relays, 112, 113, 114, 115, and 116, stand normally unattracted, closing the contact points on the right sides of the levers.

by which the various functions of the moving parts of the machine are brought about would not interest the reader nearly as much as the electrical means by which the end is attained. Suffice it to say, however, that despite the complicated appearance which the diagrammatical illustration, Fig. 1, presents, the complete machine, shown in Fig. 2, is fairly simple and of a substantial nature, capable of fully withstanding its share of accidents and abuse.

In the base of the typewriter, shown in Fig. 2, are situated 28 local magnets, one under each letter or character. When one of the group is energized the metal armature is attracted, in the same manner that a key lever on any other typewriter would be depressed by hand, and this downward movement of the lever results in printing the particular letter or other character it alone represents, of which there are 56.

In order that any particular letter or character magnet may be pressed into service at will, Mr. Barclay has devised a scheme by which a certain number of auxiliary magnets will singly or in combination, as the case may be, select the one desired and no other.

The various printing magnets, together with the spacing magnet, paper feed magnet, carriage return magnet, and type shift magnet, are shown in the accompanying theoretical diagram, Fig. 1, taken from a drawing in the patent papers.

For operating this selecting mechanism successive current-pulses are employed, which are the same in number for each character transmitted, but vary in length, the different characters being differentiated by variations in number and arrangement of dots and dashes. For transmitting the characters of the alphabet six pulses are employed for each character. The printing or other magnet corresponding to each such character transmitted is selected by the action of primary and secondary selecting relays—a sunflower and a separator relay, as hereinafter described.

The primary actuating device of this selecting mechanism is the differentially wound

polar relay 74, located in the line-current 75. The said relay controls two local circuits, 76 and 77, connected to opposing contact points of the main line relay, both of which circuits pass through coils of a neutral relay 78, termed the "separator relay," through opposing coils of magnet 79, operating escapement mechanism of the sunflower, and through a synchronizer magnet 98 to ground at 80. A battery 81 or other suitable source of electrical energy is connected to ground and to the armature of main line relay 74. One or the other of circuits 76 and 77 is completed through battery 81, according as the said armature of relay 74 is in contact with the right-hand or left-hand contact of said relay.

The main line relay 74 is very rapid in action and operates for each pulse produced in the main line whether short or long. The separator relay is more sluggish in action and completes the circuit which it controls only when a long pulse—the equivalent proportionately of a Morse dash—is sent over the line. The circuit controlled by separator relay 78 passes from ground at 83, through battery 84, the armature of separator relay 78, and conductor 85, to a plate 86 of the sunflower, to which the first five contact points 87, 88, 89, 90 and 91 of that sunflower are electrically connected. This sunflower consists of contact points 87, 88, 89, 90, 91 and 92, adapted to be moved successively by teeth of a ratchet wheel 93 during movement of said wheel through the space of one tooth. Said ratchet wheel is mounted upon a shaft, upon which is also mounted an escapement wheel 95, having three times the number of teeth of ratchet wheel 93 and controlled in its movement by the escapement anchor 96, which is actuated by the armature 97, which is polarized. The coils of magnet 79 are oppositely wound, and alternate pulses in circuits 76 and 77 will cause escapement anchor 96 to vibrate, and six such pulses, permitting rotation of escapement wheel 95 through the space of three teeth, will advance ratchet wheel 93 through the space of one tooth, causing contact points 87 to 92 to complete their respective contacts successively and completing one cycle of operation of the sunflower. The shaft 94 of the sunflower is driven by any suitable device, such as a spring motor or friction drive, which will permit intermittent motion of said shaft.

Magnet 98 beneath the sunflower is a synchronizer magnet operating an armature lever 99, having a hook which engages the teeth of ratchet wheel 93. It is not necessary to describe the action of this synchronizer, as it is not required for the comprehension of the operation of the selecting mechanism, and, indeed, may be omitted, circuits 76 and 77 passing directly from the coils of magnet 79 to ground.

It was stated that the metal frame 86, carrying contact points 87 to 91, is connected by conductor 85, passing through contacts of separator relay 78, with battery 84 and thence to ground. These contact points 87 to 91, inclusive, which may be termed "selector contacts," when operated by the movement of ratchet wheel 93, complete circuits successively from separator relay 78 through conductors 100 to 104, respectively, leading to the magnets of polar selecting relays 105, 106, 107, 108 and 109, respectively, and thence through a common return conductor 110 to ground at 111; but it will be seen that none of the magnets of the polar selecting relays will act unless at the instant when any one of those circuits is closed through the sunflower the transmission of a long pulse through the line has caused separator relay 78 to complete the circuit through battery 84 to ground at 83.

Polar selecting relays 105 to 109, inclusive, control circuits of secondary selecting relays 112, 113, 114, 115 and 116, respectively, the contact points of which are connected in tandem in the order named, the five series of contact points forming an arithmetical progression.

The primary selecting relays 105 to 109, inclusive, each control a circuit of a corresponding secondary selecting relay or relays. The controlling circuits of these secondary selecting relays 112 to 116, inclusive, are normally broken; but the armatures of the several primary selecting relays are connected by a multiple current lead 119 to a battery 120 and to ground, and when the magnet of any one primary polar selecting relay is energized by a current passing through the sunflower, and its armature is deflected, said polar selecting relay completes the circuit through the corresponding secondary selecting relay or relays which it controls, thereby operating the same.

The armatures of the primary selecting relays tend to remain in contact with whatever contact point they are against at the time. These relays are provided with a second or restoring circuit 122, passing in series through all of these relays, which circuit when completed by a restoring relay hereinafter mentioned returns the armature of all these relays to their normal positions, breaking the circuits of the secondary selecting relays. This restoring circuit 122 is arranged to be completed by a restoring relay 123 after circuit is completed through the sixth contact piece 92 of the sunflower, as hereinafter described.

Referring now to the secondary selecting relays the armature of 112 is connected to a circuit 124, arranged to be connected, through the sixth contact 92 of the sunflower, to a battery 125 and thence to ground at 126. The contacts of the secondary selecting relays are connected in tandem as follows: Relay 112 has two contact points connected by conductors 128 and 129, respectively, to movable contacts on the armature of relay 113. Each of these movable contacts of relay 113 co-acts with two contact points, each connected to a contact point on the armature of relay 114. In like manner the fixed contact points of relay 114 are connected each to an armature contact point of one of the two relays 115, and so on. The fixed contact points of relays 116 are connected to the printing magnets 24, here shown as arranged in parallel lines, and to the spacing magnet, the carriage-return magnet, the line-shift magnet, the paper-feed magnet, and type shift magnet.

It will be seen that by means of the various secondary selecting relays, anyone of the various magnets 24 may be selected at will for the completion therethrough of an energizing circuit. This is the circuit of conductor 124 and it is completed and the particular magnet is energized upon the closing of the sixth sunflower contact 92. In like manner the spacing magnet 9, the carriage return magnet 49, the paper feed magnet 59, and the type shift magnet 73, may be selected and the circuit completed therethrough upon the transmission of the selective impulses corresponding to each of these magnets.

The spacing magnet 9 is located in a common return of the circuits leading through the several printing magnets 24, so the said magnet is energized each time one of the printing magnets is energized. Said spacing magnet is nevertheless arranged to be selected and a circuit completed therethrough upon the transmission of a corresponding selective group, this being necessary in order that the spacing mechanism may be operated at will when no character is to be printed, as, for example, when spacing between words. It is preferable to employ for the operation of the spacing magnet alone three dots. This will not cause any of the secondary selecting relays to be energized, but will cause the sunflower to operate, and thereby, on the completion of the sixth pulse, to complete a circuit through conductor 124, and a back stop (right hand contact) of a secondary selecting relay of each of the five series of such relays, through conductor 139, the spacing magnet, and thence to the common return. The circuit of conductor 139 passes through contact points, normally closed, of a spacing cut-out relay 141 and through another contact 142 of the type wheel shift mechanism, contact 142 being also normally closed. The spacing cut-out relay 141 is employed, because otherwise circuit would be closed through the sixth sunflower contact and the back contacts of the secondary selecting relays to the spacing magnet 9 upon the return of the armatures of the said secondary selecting relays to normal after the transmission of each character. This spacing cut-out relay 141 is connected in multiple with restoring relay 123 in a circuit closed by the completion of the sixth sunflower contact, and, like relay 123, relay 141 is somewhat sluggish, so much so that upon the transmission of a message consisting only of dots it permits the circuit of magnet 9 to remain closed long enough for the operation of the spacing mechanism, but nevertheless breaks said circuit of magnet 9 after the transmission of any signal which causes the operation of one or more of the secondary selecting relays, through the operation of the restoring relay 123, the armatures of said secondary selecting relays can have reached their back stops.

In an equally ingenious manner Mr. Barclay has devised precautions against de-energizing the carriage return magnet through the operation of the restoring circuit and relay before the carriage has returned to the starting point, and in many other ways safeguarded the action of every movable part of his invention.

TRANSMITTING DEVICE.

It has been shown that the letters and other characters required to select and operate their respective magnets are each composed of six electric pulses. Five of these must act successively before the sixth, and it is the sixth that actually causes the printing. It is obvious that any device which will do this must possess a great rapidity of action. Although the characters are composed of dots and dashes, or a combination of both, the best Morse sending operator would be unable to operate the receiving typewriter by hand-produced signals because his dots would become comparatively long pulses and at certain periods actuate magnets that should be left dead. In other words he could not execute the first five pulses during the time occupied by the armature of the sixth pulse magnet in its transit.

Mr. Barclay has about completed a mechanical transmitter which will perform this work and operate the distant receiving apparatus direct from the sending station without previous perforation or other preparation, but pending the perfection of certain details his letters and other characters are first prepared by means of perforated paper tape which latter is then run through a Wheatstone transmitter. By this means any desired speed may be obtained.

To illustrate the manner in which the armature levers of the five relays 112, 113, 114, 115, and 116, respectively, are set for the formation of a given letter, let us take the letter A for an example. Letter A in this system is a dash and two dots, thus — - -, six pulses in all, counting the dash, space, dot, space, dot, and a last or sixth pulse which completes the cycle of the sunflower containing the six levers and contact points, five of

which are connected, respectively, to polarized relays 105, 106, etc.

The closed contact points of these relays control the five distributing, or route-making, relays, hence any long pulse that closes one of the polarized relays also sets the lever of its companion magnet in group 113-116 to the left.

As the letter A has but one long pulse (ignoring the sixth, which is always long), and as this is the first of the six, the first lever of the sunflower, No. 87, catches the long pulse and closes relay 105; the contact point of this in turn closes the circuit through the magnet of relay 112, thereby throwing the lever of that relay to the left. As there was but one long pulse transmitted none of the other relays in group 105-109 were affected, hence all the relay levers in group 112-116, except No. 112, remain in their normal position on the right-hand contact point.

If now we trace the path made by the closing of relay 112 alone, it will be found that, starting from the grounded insulated lever of this instrument 112 it leads to the magnet marked A in Fig. 1. If three long pulses were sent through the transmitter in rotation (— — —), which is the combination for the formation of letter K, the first, third and fifth levers of the sunflower would catch them and successively set the levers of relays 112, 114, and 116 to the left.

Again tracing the closed route to the group of magnets 24, the reader, by remembering which relays are closed will find that it leads to magnet K. The space-between-words magnet is formed by three dots or six short impulses. As none of the relays can be effectually energized by such pulses, the levers of all relays in group 112-116, of course, remain in their normal position on the right-hand contact point. Tracing from the same point again, the path leads to the spacing magnet No. 9.

In a similar manner other combinations in the arrangement and regulation of the long and short pulses transmitted, will provide direct circuits to the various magnets through the corresponding positions the levers of relays 113-116 are caused to assume.

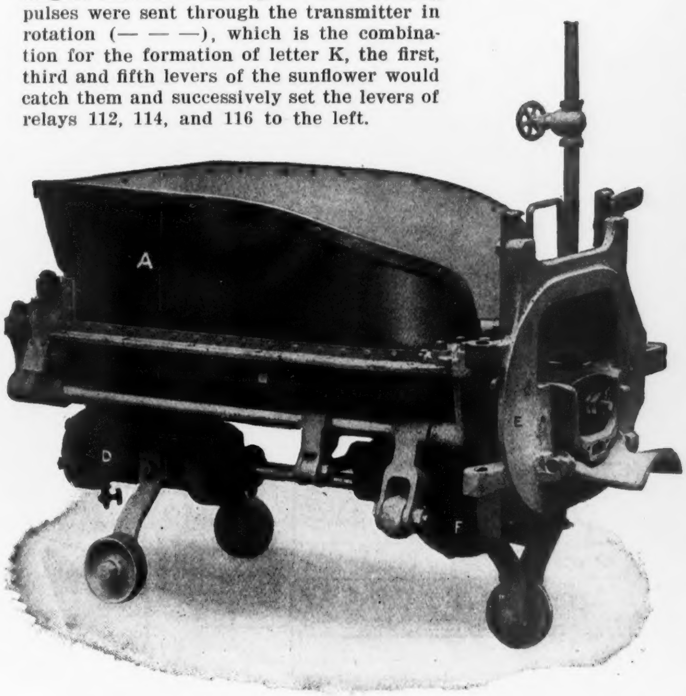
The various German states are now engaged in negotiations for what in this country would probably be called a "pool" of their railroad rolling stock, including locomotives as well as cars, which promises to be of very great importance and to do away with much of the carrying of freight by circuitous routes, as well as otherwise making more efficient use of cars especially. Many of these states are too small to work their railroads economically, but Prussia is so overwhelmingly powerful that they fear to consent to ownership or operation by the Empire, or to such a joint operating union as Hesse made with Prussia a few years ago.

The Victor Stoker.

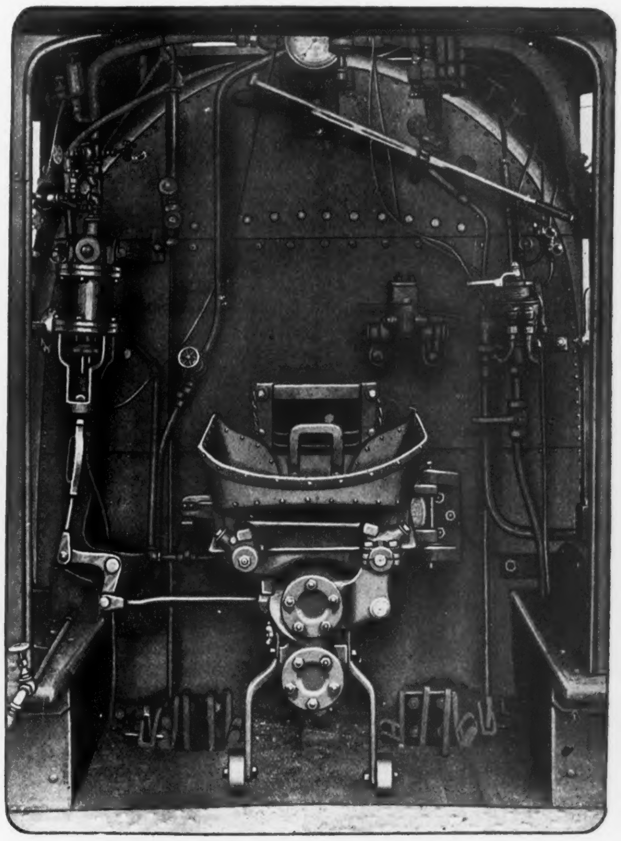
Those who were familiar with the general features, of the Kincaid locomotive stoker, that was first exhibited at the Saratoga convention three or four years ago, will recognize an old acquaintance under a new name in the Victor stoker that has now been introduced somewhat extensively, experimentally, on a number of engines on the Big Four. Since the device was brought to the attention of the railroad world, it has undergone some modifications of details, but the original principle has not been changed and the machine is the same in its essential feature as at the start. It consists of a hopper in the bottom of which is a steam cylinder with a piston moving to and fro driving a trunk which propels the coal into the firebox at varying velocities so that it is evenly distributed over the whole surface of the grate. The valve mechanism for this operating cylinder is driven by a special engine, that also drives the feed worms whereby the coal is carried forward to the front of the plunger by which it is thrown into the firebox as already stated. These worms lie at the bottom of the hopper at each side of and a little above the operating cylinder. This, in brief, is an outline of the mechanism which may now be examined in detail.

The original device was described in the *Railroad Gazette* for May 24, 1901.

The present construction consists of a hopper containing all of the mechanism, which is shown in the accompanying illustration.



The Victor Stoker.



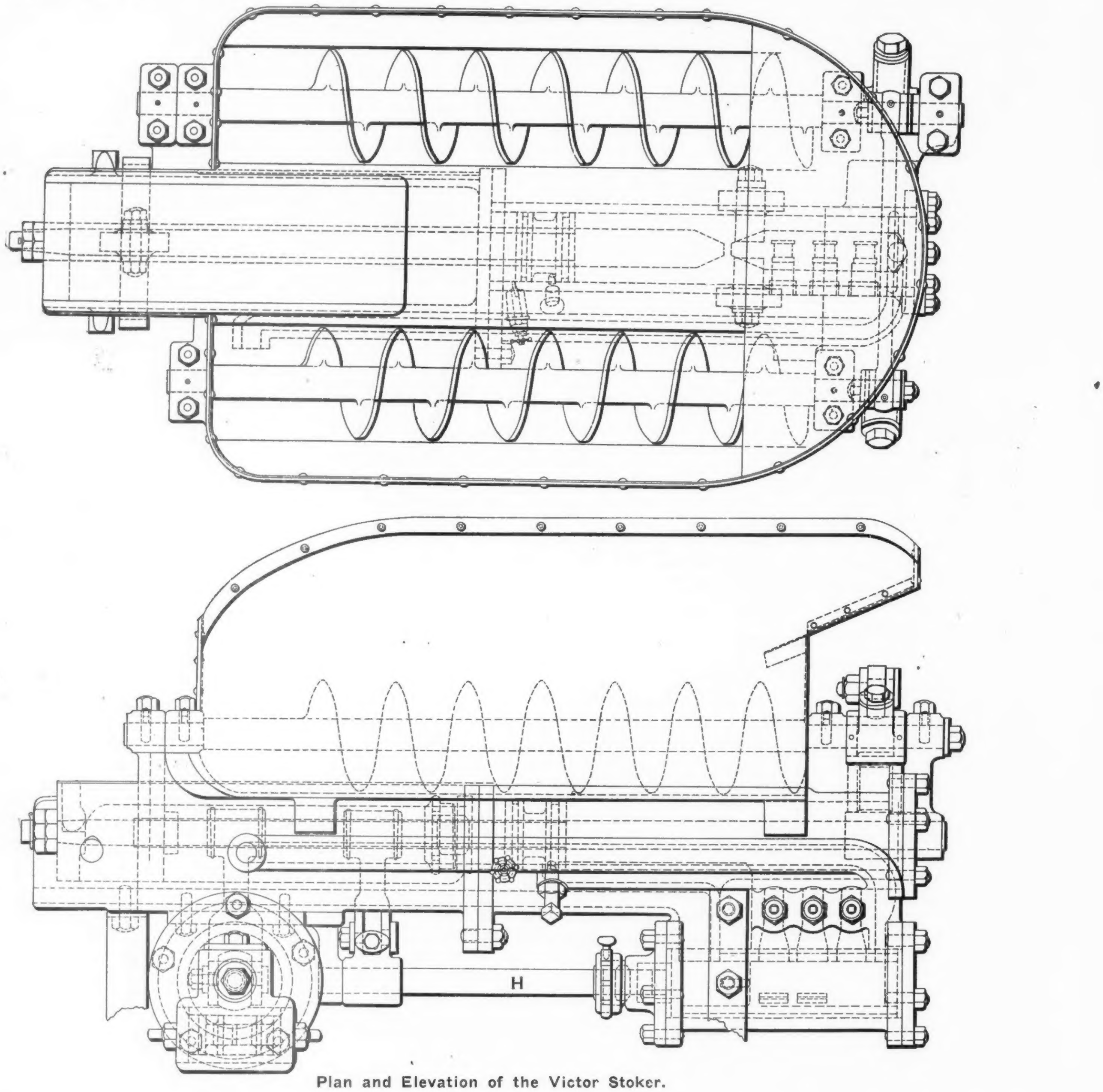
View of Back Head Showing Stoker in Position.

Two general types of stokers are built; one with the operating cylinder bolted to the back head of the boiler and working the stoker valves through a series of levers and bell cranks, the type used on the Big Four road; and one with the cylinder integral with the stoker, as shown in the illustrations. In the latter, Fig. 1 is a vertical longitudinal section along the center line. In this A is the operating cylinder, which will be described in detail later. As the piston of this cylinder moves to and fro it carries with it the lever B (Fig. 2) by which, in turn, the ratchets turning the worms are driven. At the same time the arm D that is keyed to the same shaft, C, as the arm B, works the connection F, by which a ratchet on the valve stem H of the plunger valve is turned. This latter (shown at I, Fig. 1) is a hollow trunk valve with three ports located 120 deg. apart; two of which appear in the section. As the valve is rotated, steam is admitted consecutively to the plug valves 1, 2 and 3. These valves are adjustable and are set to wire draw the steam to a greater or less extent, by which any predetermined amount may be admitted to the plunger cylinder, K. It is evident that the wider the opening in these valves the greater the amount of steam passed and the more rapid and violent will be the forward movement of the plunger. By this means the rapidity of the stoker is regulated. Ordinarily these valves are adjusted so that on one stroke the movement will be of such speed as to throw the coal to the front of the firebox; at the second it is strewn over the middle section and at the third it drops close to the back. Steam is admitted to the interior of the valve through the live steam port, and, following the direction indicated by the arrows, enters the cylinder K, and

forces the piston forward until it covers the small port, L. At the next stroke of the engine the ratchet blanks the outlet from the valve and opens the exhaust at M. Then steam admitted at the small port N forces the plunger back, while the next stroke opens an exhaust from L and permits the piston to be forced to the front again. The outer end of the piston rod carries a head and shield by which the coal is thrown into the firebox.

The latter enters over a deflector plate that is subjected to the heat of the furnace, the plunger and is thrown into the firebox at the next stroke. The controlling engine is a simple and ingenious affair and is deserving of notice.

It is a modification of the Westinghouse air pump engine. The cylinder is placed either upon the boiler head and operates the stroke through a bell-crank and suitable connections or it is built in as a part of the apparatus and located transversely, and does its work by a direct connection to the levers as shown in the illustration. In the case of the engines upon the Big Four, the cylinder is bolted to the boiler head. The piston in moving to and fro in the cylinder strikes a reversing rod that is attached to a small circular valve. The bottom of this valve is cut with ports, as shown in the illustration. The two ports marked AA are for the exhaust, and those BB for the passage of live steam. The exhaust passage being central with the valve, it follows that no matter what position it may be in, one is in communication with the exhaust, while the circular port opposite is admitting live steam through the corresponding port at the other side. The two side ports lead, as shown in the cross section of the controlling engine, to the ends of the space in which the float valve O is placed. This alternating admission of the steam to the two ends of this space forces the valve to the right or left as the case may be. Referring to the illustration, when the float valve has been forced to the right, as shown, the end uncovers a leakage port by which steam passes over the end lug to the space marked (1). From there it flows out at the holes shown by dotted lines to the cylinder and operates the piston.



Plan and Elevation of the Victor Stoker.

with what cooling can be effected by the inrush of cold air as the plunger is drawn back. These plates are made of cast-iron and last for about 40 days.

When the coal is fine the worms carry it forward in such quantities that it can all readily pass through the opening at the front. Occasional lumps are cared for by the sliding door with a deflecting lip as shown at P on the outer face. As a lump strikes this, the door is lifted and the coal passes on. Sometimes it occurs that even with the door raised the lump is too large to pass; it is then broken by the blow of

At the same time exhaust from the other end is passing out at the row of dotted holes at the right, through the exhaust space (2) to the holes of the center line and thence to the atmosphere. When the piston reaches the other end of the stroke the reversing valve is moved so as to admit steam to the right of the float valve, which is forced to the left and the reversal of the piston takes place.

Push plugs are located at each end of the float valve chamber so that the latter can be started by hand if it should stick at any time.

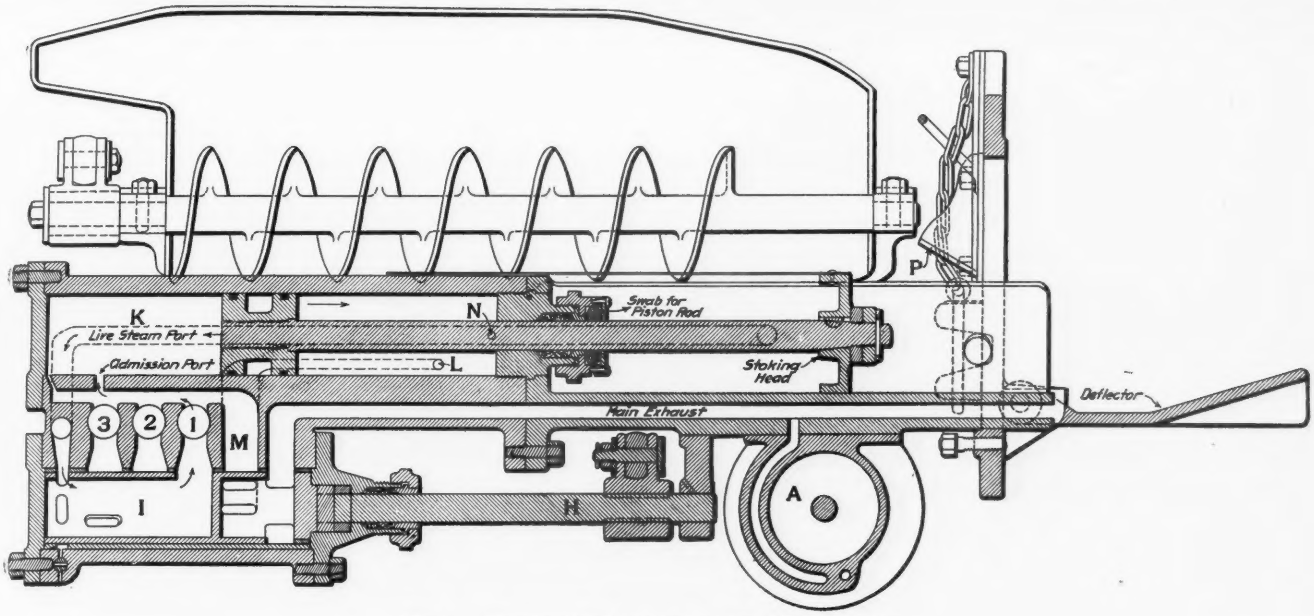


Fig. 1—Longitudinal Section of the Victor Stoker.

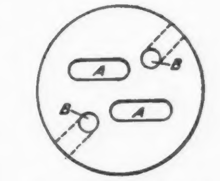
It will be seen that the mechanism of the stoker is exceedingly simple; that there is no fine work upon it; that there is little to get out of order, and that any man of ordinary ability should be able to master it in a short time. It is convenient in many ways, in that the whole top can be turned back and cleaned in case of clogging without interfering with the fire, an operation that can be readily accomplished in from three to four minutes.

This simplicity of the construction of the device may convey to the uninitiated the idea that its manipulation is also reduced to the simplicity of the brute strength required to shovel coal. When stripped of all skill the fireman has merely to shovel coal from the tank into the hopper and the stoker will do the rest. As a matter of fact, however, the manipulation of the apparatus requires as much skill as hand firing, if not more, in that it admits of closer regulation and can be adjusted to a nicety to meet the demands of the engine. This can be well illustrated by the log of a trip from Cincinnati to Indianapolis on an engine fitted with the stoker.

The engine was of the Atlantic type with cylinders 21 in. in diameter and a 26-in. stroke of piston. The firebox was 68 in. wide and 97 in. long on the inside. The train consisted of eight cars as follows: One postal car, one baggage, two coaches, one parlor car, one dining car and two sleeping cars, eight in all, with a total weight of 408 tons, to which it would be fair to add at least 32 tons for passengers, baggage, express and mail, so that the load behind the tender can be placed at about 440 tons. The distance from Cincinnati to Indianapolis is 110.8 miles, and there were three stops, the schedule time being three hours and five minutes.

On starting the steam pressure was 178 lbs. The fireman first raked the fire, and three minutes after starting the stoker was put into action. In two minutes the steam pressure was 185 lbs. This was at 8.35, the train having left the station at 8.30. Owing to the freshness of the fire, the starting of the injectors and other causes, the next 15 minutes saw a fall of 20 lbs. in steam pressure, which stood at 160 lbs. at 8.50. At that time the engine was working easily on a slightly descending grade though running at a speed of about 50 miles per hour, and, with the injectors shut off, the next five minutes saw an increase of 20 lbs. so that at 8.55 it was 180 lbs. The rise continued, until at 9 o'clock it was 190 lbs., and at 9.05 it was just below the 200 mark, where the safety valves were set to blow off. The speed at this time was about 55 miles per hour. The first stop was at Lawrence Junction, 22.7 miles out.

To this point the road was along the banks of the Ohio on a descending grade for most of the way. Just beyond Lawrence Junction it leaves the river and climbs a hill 13 miles long on a gradient that starts in at 26 ft. to the mile and holds this for 5½



Reversing Valve of Victor Stoker.

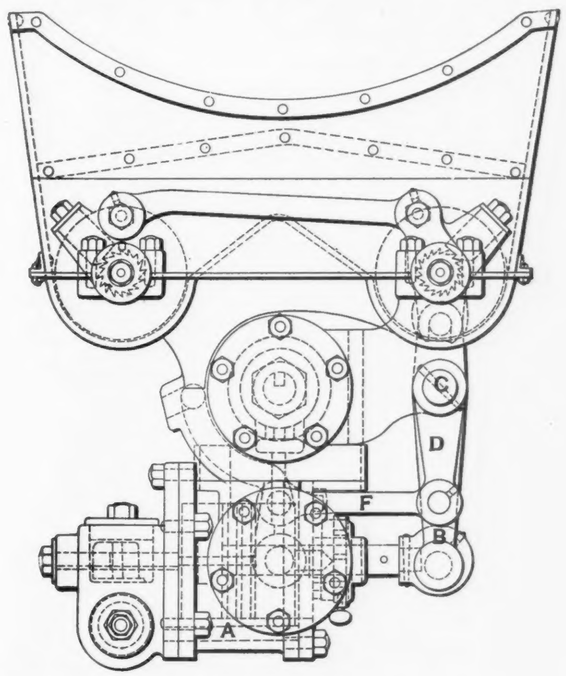
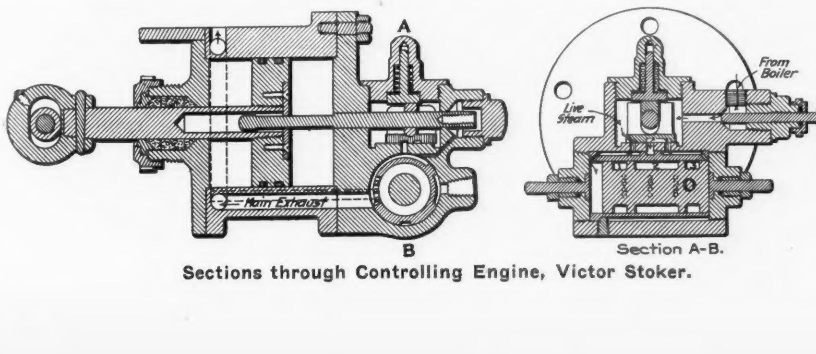


Fig. 2—End View of Victor Stoker.



Sections through Controlling Engine, Victor Stoker.

miles and then rises at the rate of 55 ft. for the remainder of the distance. Thirty-five minutes were occupied in climbing this hill, giving an average speed of a little more than 23 miles an hour for the whole distance, over the whole of which the steam pressure was well maintained. It was 190 lbs. at the start. In eleven minutes it had risen to 200 lbs. During the next five minutes with both injectors working it dropped back to 180 lbs., but the following five saw a recovery to 190 lbs. From the top of this grade into Indianapolis, a distance of about 71 miles, the profile is undulating with easy grades and almost an air line. In running this section the speed was high, touching 60 miles an hour in spots and being continuously above 48 or 50. For the greater part of this run the steam fluctuated, dropping at one time from 195 to 175 lbs. in ten minutes, under the action of two injectors, and then recovering in the next five to 200 lbs. At one place it dropped to 160 lbs., but ten minutes brought it back to 190 lbs. In short the matter seemed to be wholly in the hands of the fireman, who showed no uneasiness at all on a falling gage. At Greensburg 21 minutes were lost in caring for a hot box, and of this nine minutes were made up on the run to Indianapolis, a distance of 47 miles, scheduled to be made in 65 minutes with one stop. The actual running time between Cincinnati and Indianapolis was 2 hours and 49 minutes, or an average of 39.3 miles an hour while in motion, and this, it must be remembered, includes the passage of the long grade out of Lawrence Junction.

The trip on which this log was taken was essentially in the nature of a surprise, as not an officer of the road or the stoker company knew that it would be made, with the single exception of the railroad official who issued the engine permit ten minutes before the departure of the train. It may, therefore, be taken as fairly representative of current practice.

As for the quality of the coal used, it was fine, almost powdery, run-of-mine from the Kanawha district in West Virginia. While an analysis of the coal used on the run detailed is not available the general average of coal of this district is as follows:

Moisture	0.93
Fixed carbon	75.37
Volatile matters	21.83
Ash	1.87
	100.00
Sulphur (in ash)	0.26

It was kept thoroughly wet, so that there was no flying dust. The few lumps were broken before throwing into the hopper. In fact, it has been found that the stoker handles fine material better than it does lump and is able to distribute it more evenly over the bed.

It is to this that must be attributed to a great extent the successful operation of the device. It is found that on reaching terminals the bed of fire is from 6 in. to 8 in. thinner than that carried on engines run with hand firing, and, in the case of the engine under consideration, the bed was smooth and even over its whole surface upon arrival at Indianapolis, and the engine was sent back to Cincinnati without having its fire cleaned.

Those who have an idea that the use of a mechanical stoker means the substitution of unskilled for skilled work on the part of the fireman are very wide of the mark. As a matter of fact the stoker requires rather more skilful attention than hand firing does. With the coal used on the trip under consideration, the rake was used but twice; once just after leaving Cincinnati and again after reaching the summit of the long grade out of Lawrence Junction. But the stoker was the object of constant attention.

On normal and average working the plunger made about 20 strokes to the minute, but by varying the speed of the operating engine this was raised to 25 and cut down to 10, to meet the requirements of the fire. Occasionally it would be stopped for a few moments.

This was done 25 times on the trip; the total standing time being 62¾ minutes out of the total of 197 occupied in the run between terminals. This includes station stops and approaching the same. The idle time with the engine working rarely exceeded one minute at a time, and was often no more than ¼ minute.

The quality of the results obtained, therefore, depends upon the skill of the fireman who is as busy as ever but is not overtaxed physically. About three and a half tons of coal were burned in these three and one-quarter hours, but the fireman did not shed a drop of sweat though the day was a fairly warm one in May. He was well back from the boiler head when shoveling coal and had merely to lift it from the floor of the tank to the stoker hopper, which was about 30 in. high. There was no fire door to open and no exposure to the direct heat of the flame. In this respect the labor is wonderfully lightened, though there is probably not much difference in the actual quantity of coal consumed. It is wholly in the way in which it is done. The hopper can be filled in any way, with no regard to the placing of the coal, and then for an interval of five or six minutes there is a chance for rest.

It follows from this that the stoker is popular with the men on heavy runs. Some take to it much more naturally than do others, and some, in whom conservatism and objection to every innovation is inbred, never get reconciled to it, despite the saving in muscular exertion. An amusing example of this occurred at Greensburg. An engineer who had never seen the stoker climbed on to look at it. Before he had reached the other side of the cab he said: "I don't like it?" He couldn't see exactly why and so asked: "Does it keep her hot?"

"Yes."

"Well, p'raps it will do, but I don't think I'd like it."

The men who shovel the coal do like it, and what is very much to the point, usually ask for a lay-off if they find they are assigned to a run with hand firing when they have been accustomed to the stoker.

In this there is much in custom. It is probable that a goodly portion of the success that is attending this experimental work on the Big Four is due to the fact that seven passenger engines have been equipped, so that a number of crews can be drilled in the use of the device at once.

Past experience has also shown that if but one engine in a pool were to be equipped, where a dozen or 15 crews would be assigned to it at odd intervals, that results would be unsatisfactory and the men would be down on the device, simply because none of them would know how to handle it skilfully. The proper method to pursue in the introduction would be for the officials to investigate and decide on the probability of the device meeting their requirements, and then boldly attack the problem by equipping every engine on a division, so that all crews can be drilled at once and not be confined to the shifting and occasional work on a single engine.

That the device, as it stands, has reached its final stage of development is not to be expected or considered. It is simply in such shape as to demonstrate its practicability. It labors under the disadvantage of being worked on an engine built for hand firing. It is probable that with one built expressly for the use of the stoker much more room would be available in the cab than there is at present. The stoker stands on three legs and has a slightly unsteady motion in that it is not rigidly fastened. This is necessary so as to permit its ready removal in case of a failure, which can be done in about ten minutes.

It is probable, too, that some further improvement can be made in the door conveniences. As it stands at present, the opening above the plunger is so small that it is exceedingly difficult to get a good view of the fire, and this becomes still further obstructed when a rake is put in to smooth off the bed. It is evident that no matter how reliable the stoker may be, it is desirable that the operator should be able to examine the condition of the fire at any time.

In the matter of combustion, the stoker is by no means a smoke preventer. There was a stream of black smoke issuing from the stack during the whole of the time that it was in operation. It was possible, however, to count the strokes of the plunger by the appearance of this smoke. As this was drawn back and the opening into the firebox left clear, the density of the smoke perceptibly decreased, showing that this admission of air above the fire served to promote the combustion of the smoke-producing hydrocarbons. But even with this, there was not enough to clear it up entirely, and finally the smoke was perceptibly less with the engine working harder than when the cut-off occurred early in the stroke. These facts suggest that it might be advisable to put a number of tubes through the back head so as to admit air for the purpose of promoting the combustion of the volatile gases. These things, to be sure, have nothing to do with the stoker in itself, but are merely related matters that suggest themselves as worthy of consideration.

As to maintenance, the railroad officials report that in five months it has cost practically nothing. Of course there is some wear, as must needs be the case with any working piece of machinery, but up to the present no reliable figures are available because renewals and repairs have not been called for.

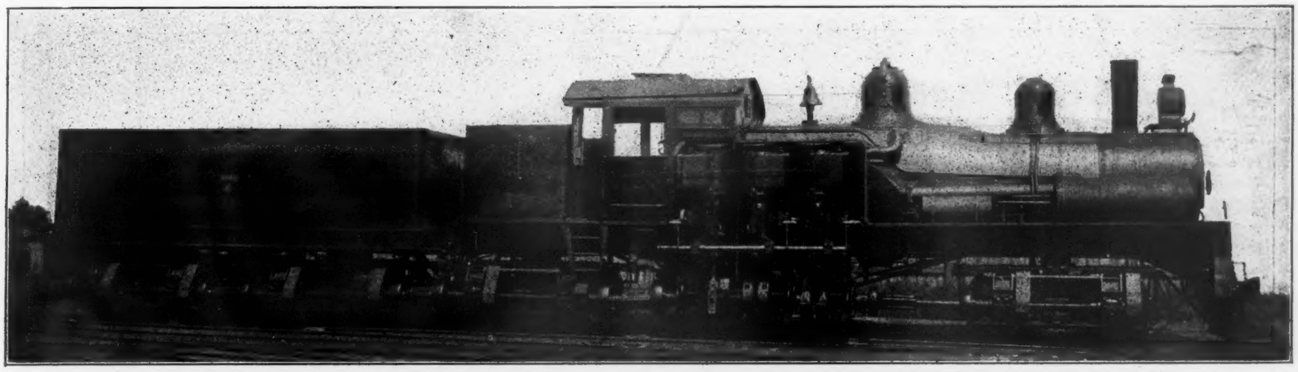
The subject has been treated thus in detail on account of the growing opinion that the modern locomotive has outgrown the physical capacity of the man. To take a heavy engine over a long division and keep it working up to its maximum efficiency at all times is more than the average man can accomplish with hand firing. Yet these big engines are an economic necessity, and the one outlet to the dilemma lies in the mechanical stoker, whereby the fireman is freed from the exhausting exposure to the heat of the furnace at the same time that the actual handling of the coal is made much easier. Add to this the fact that the agitation of putting three men on the engine has already reached the stage of presentation to the legislatures of Indiana and Ohio, for legal requirements, the officials of all roads are looking earnestly for a solution of the problem. Thus far it is a peculiarly American one, for in no other country has the locomotive outgrown the man at the shovel. But in the United States at least the mechanical stoker is most decidedly a topic of the day for the motive power department.

A corporation consisting of steam and street railroad employees has begun the construction in Rome of nine buildings to serve partly as tenements and partly as co-operative stores, etc. The land for the site has been sold by the city for a fraction of the ruling price. The buildings will be four stories high, and will contain rooms for a co-operative bakery, a pharmacy, grocery and other supply stores, and an electric light plant. Each building will have a laundry, and there will be a bath-room on each floor. The separate quarters for a man or a family

have one, two, or three rooms, and there will be 700 of them. The money is raised by shares costing about $5 each.

Tests of a Heavy Shay Locomotive.

Shay locomotives, in common with those of other types, have steadily increased in weight and power. A machine of this type which is remarkable for its large size has recently been placed in service on the Keeney's Creek branch of the Chesapeake & Ohio, and its performance is a matter of such significance that a description of its work as a hill-climber is of unusual interest. An illustration of the locomotive is shown herewith.



Shay Locomotive for Chesapeake & Ohio.

The Shay locomotive, as is well known, exhibits a wide departure from the ordinary lines of locomotive design. The engine is vertical and has three cylinders driving a three-throw crank-shaft. An extension of this crank-shaft having telescopic universal joints transmits the power of the engine to all the trucks of the locomotive and tender in such a manner that while all the axles are driving axles, the radial motion of the trucks is not interfered with. The whole weight of the locomotive and tender is by this means made available for adhesion while its flexibility is such as to permit it readily to pass curves of very short radius. These features make the machine well adapted to its work on heavy grades and crooked track. Obviously, the complication of the transmitting shaft with its heavy flexible joints, and the presence of gears for transmitting the motion of the shaft to the axles, preclude all possibility of high speed.

The principal dimensions of the locomotive illustrated are:

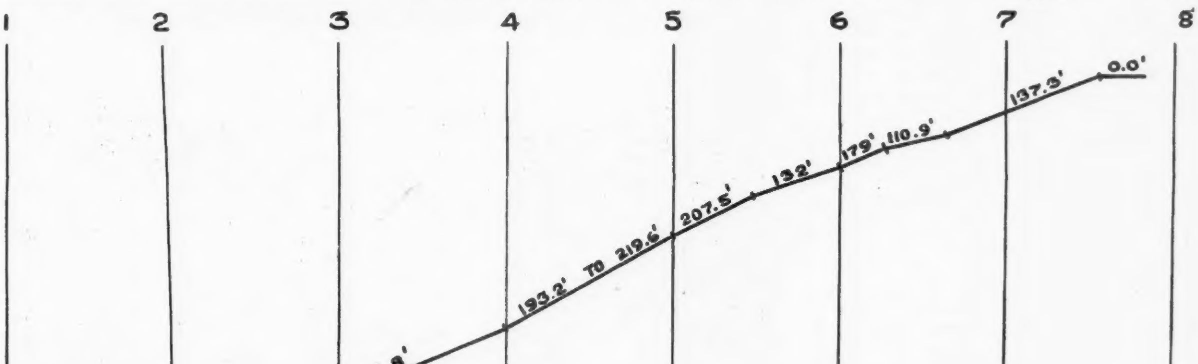
Cylinders	3 vertical, 17x18 in.
Valves	Allen-Richardson
Wheel diameter	46 in.
Boiler	Extended wagon-top
Staying	Radial
Diameter at first ring	62⅝ in.
Steam pressure	200 lbs.
Heating surface, tubes	2,164 sq. ft.
" " firebox	168 "
" " total	2,332 "
Grate area	42.75"
Weight, working order, eng. & tender	330,600 lbs.
Rigid wheelbase	69 ft.
Total wheelbase	59 ft. 4 in.
Length over all	69 ft. 4½ in.

This locomotive is in service on a seven-mile branch of the Chesapeake & Ohio. It hauls empty coal cars and miscellaneous freight up the grade, distributing the cars to the several mines on the way, and brings down loaded coal cars. The nature of the service demanded can be judged by a glance at the accompanying diagram, which is a profile of the line. The maximum grade is 219.6 ft. per mile, or 4.16 per cent., and the maximum curvature is 14 deg., both occurring together between the fourth and fifth mile posts.

Road tests of the engine have been made on this branch under service conditions with results which are of more than ordinary interest. The tests were conducted by Mr. Charles A. Bingaman and Mr. Edmond Orchard,* representing the builders, the Lima Locomotive & Machine Co., Lima, Ohio, and by Mr. D. L. Eubank and Mr. W. J. Hood, representing the railroad company. The regular engineman and fireman handled the locomotive. There were three tests which were of necessity on the up trips as on the

*We are especially indebted to Mr. Orchard for courtesies extended in connection with these tests.

		Sept. 29, 1904.	
		A.M.	P. M.
Date	Sept. 28, 1904. No. 1.	No. 2.	No. 3.
No. of empty cars at start	18	20	17
Total train weight, including eng. and tender, tons	512	510	438
Net train weight, from start to fifth mile post, tons	357	350	278.6
No. of cars dropped at fifth mile post	1, or 19.7 tons.	5, or 93.25 tons.	0
Ton-miles to fifth mile post	1,758.5	1,750	139.3
Net train weight from fifth to sixth mile post, tons	332	215.5	278.6
No. of cars dropped at sixth mile post	7, or 136.2 tons.	10, or 255.25 tons.	7, or 113.9 tons.
Ton-miles, fifth to sixth mile post	332	215.5	278.6
Net train weight from sixth to seventh mile post	195.8	94.75	164.7
No. of cars dropped at seventh mile post	10, or 195.8 tons.	5, or 94.75 tons.	7, or 113.9 tons.
Ton-miles, sixth to seventh mile post	195.8	94.75	113.9
Total miles	7	7	7
Total ton-miles	2,286.3	2,060	1,836
Running time, minutes	73	81	55
Average speed, miles per hour	5.7	5.26	7.16
Total coal, lbs.	3,100	3,100	2,500
Total water, lbs.	27,327	27,327	21,807
Water evap. per sq. ft. of heating surface per hour	9.53	9.53	5.61
Water evaporated per lb. of coal	8.81	8.81	8.72
Coal burned per sq. ft. of grate per hour	58.2	58.2	62.3
Ton-miles per ton of coal	1,524	1,329	1,469
Rail condition	Good.	Slippery.	Good.



Profile of Keeney's Creek Branch—Chesapeake & Ohio.

down trips the engine has nothing to do but hold back the train.

The results are shown in the table on page 647 and in those that follow:

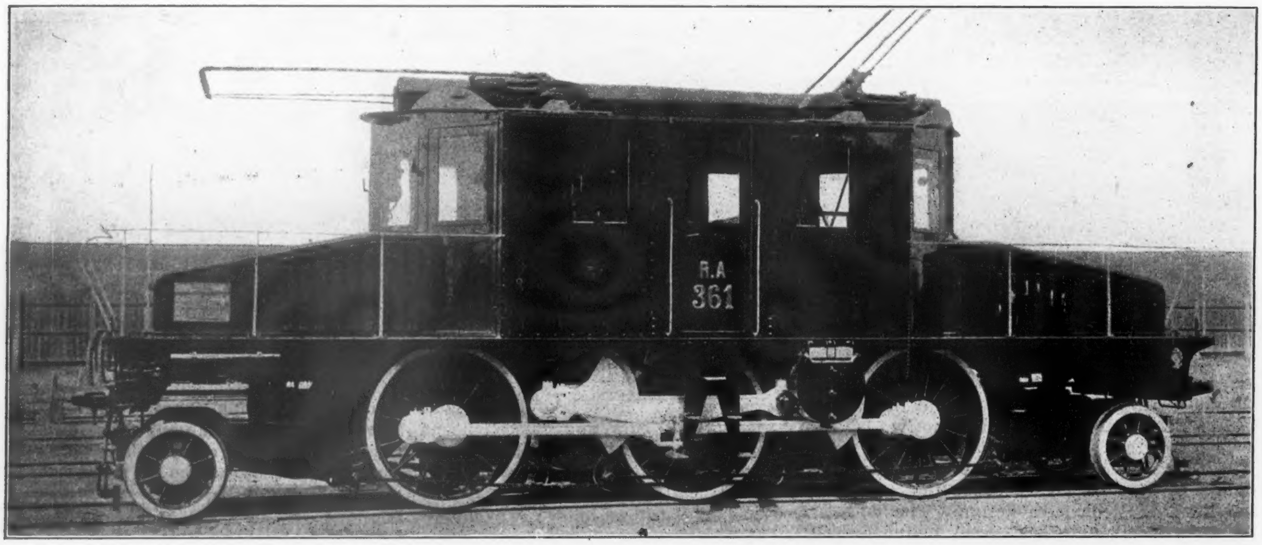
Results Obtained Between the Fourth and Fifth Mile Posts.

Reverse lever, notch	10
Revolutions per minute of engines	44
M. E. P.	152.7
I. H. P.	408
Drawbar pull equivalent to M. E. P.	53,000

Results Obtained Between the Second and Third Mile Posts.

Reverse lever, notch	10
Revolutions per minute of engines	116
M. E. P.	115.5
I. H. P.	814
Drawbar pull equivalent to M. E. P.	40,090

A comparison of the Shay engine with the C. & O.'s G4 type showed a great advantage in favor of the former, which could pull 19 cars up the grade against seven for the other.



The Latest Type Ganz Three-Phase Electric Locomotive—Valtellina Line.

The Valtellina Line and the Electrical Operation of Railroad Main Lines.*

BY THEODORE KÖHN.

(Continued from page 402.)

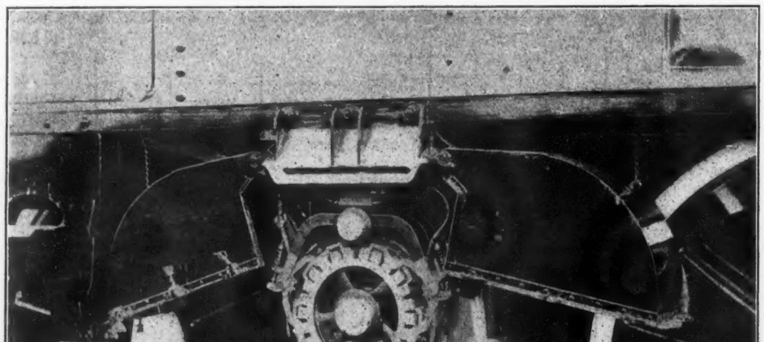
VIII. NEW ELECTRIC LOCOMOTIVES FOR PASSENGER AND FREIGHT TRAINS.

The confidence of the railroad commissioners in the propulsion of trains by three-phase current is evident from the fact that on October 15, 1902, immediately after the beginning of regular electric operation on all three lines of the Valtellina Road, a private (or closed) advertisement was issued for three additional electric locomotives, which were to have a considerably greater capacity than those first built, and be equally well adapted to the hauling of heavy freight and passenger trains. The essential requirements were as follows: The locomotive is to be provided with two double-axled trucks, placed under one frame, and not with two flexibly connected trucks, as on those first delivered. The crew is to be able to get from the locomotive into the next car conveniently and safely. The locomotive is to be capable of traveling in either direction with equal ease and at the highest speed. The motors, aside from the revolving part, are to be flexibly mounted. The use of gear-wheels is precluded. The motors are to permit of two speeds, and at 30-40 kw. per hr. are to develop at least 6,000 kg., at 60-70 km. per hr., at least 3,500 kg. tractive effort at the periphery of the wheel. At starting, the pull is to be sufficiently great to accelerate a train of 400 tons, including the locomotive, on a straight track of .1 per cent grade, from 0 to 30 km. per hr. in 55 seconds, and a train of 250 tons from 0 to 60 km. per hr. in 110 seconds. This acceleration is to be obtainable even with a tension of 2,700 v. between the two trolley-wires. Starting shall be possible with a train of 250 tons even on a two per cent. grade. The electrical equipment of the locomotive is to be such that starting and acceleration from 0 to 30 km. per sec. may be repeated at least 30 times at intervals of 120 seconds. The motors are to stand an overload of 100 per cent. at least 100 seconds, and one of 50 per cent. at least an hour, and to run 10 hrs. at full load and full speed, in which case the temperature rise shall not exceed 60 degrees C. above the temperature of the surrounding air. Ganz & Company offered to deliver locomotives with four motors, concentrically mounted on the axles, as used on the cars and locomotives first delivered, but before the award of the contract made an alternative offer, according to which the motors were to be placed between the axles and joined to the driving axles by connecting rods. The order was given to Ganz & Co. on the basis of this last arrangement.

The first locomotive was delivered in May, the last in July, 1904. After a very careful examination while unassembled, and after all the tests called for in the specification had been made, the first locomotive was turned over for regular service with passenger and freight trains at the end of June, and the other two in the month of September. The acceptance tests were made with the participation of a committee delegated by the Italian government. Among the members were Prof. Arno, who expressed his satisfaction after the conclusion of the trials, in the following words: "The results of this day's tests constitute a truly wonderful advance."

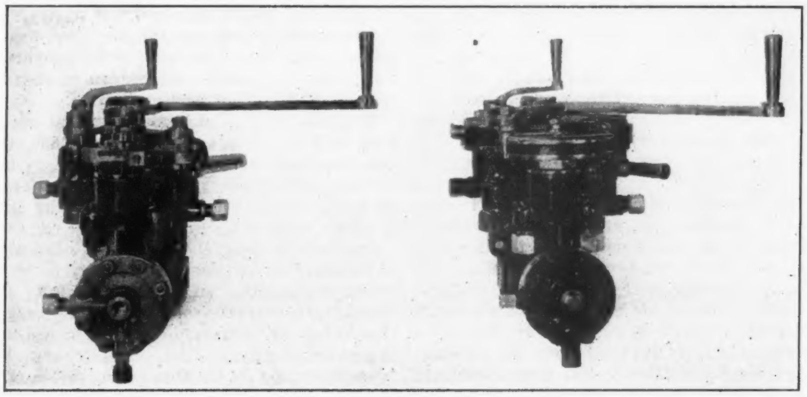
The style of construction which was actually adopted has five axles, three connected and two pilot axles, of which one connected and one pilot axle each are mounted together on one truck. The outer connected-axles have a lateral play of 25 mm., the king-bolt of one truck has a lateral play of 25 mm. to each side; that of the other is fixed, allowing only a rotating motion of the truck.

One high and one low tension machine are combined in one housing, the shaft passes



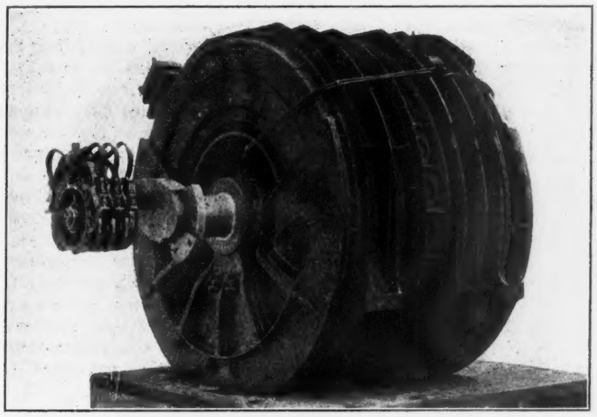
Contact Rings and Housing—Ganz Locomotive.

*Translated from the *Organ für die Fortschritte des Eisenbahnwesens*, November, 1904.

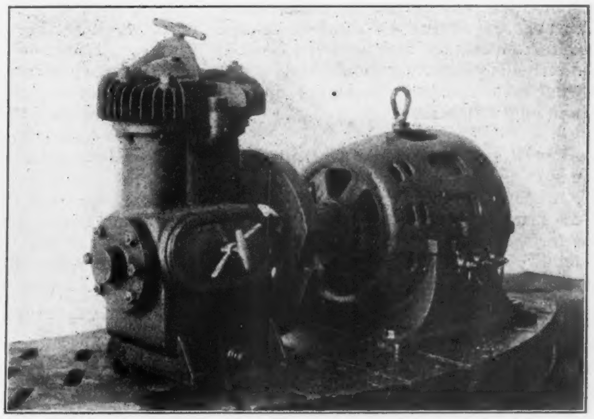


Electro-Pneumatic Controllers—Ganz Three-Phase Locomotive.

through the frame bearing and has a crank at each end. The crank pins of both motor-shafts are united by a connecting-rod, which drives the middle driving-axle directly, and the outer ones by means of connecting-rods. The pin bearings of the middle axle have vertical play, so that there is free relative motion between the uncushioned crank pins of the middle driver-axle and those of the motors at the connecting-rod, which are spring supported.



Ganz Three-Phase Combined High and Low Tension Traction Motors.

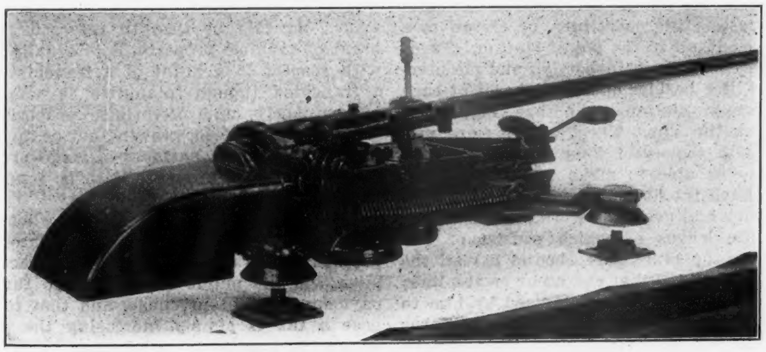


Motor and Air Compressor—Ganz Locomotive.

The discarded concentric arrangement of the motors and driving-shafts has the drawback that the link-coupling is inaccessible, a condition which may cause trouble in operation. For this reason the Rete Adriatica demanded a type of construction at variance with the specifications, having motors located between the axles, and suggested the idea of driving by means of connecting-rods. Independently, the same idea was followed up by Ganz & Company, at the instance of Chief Advisor of Construction Gölsdorf, in Vienna. The result of this investigation is that devised by Koloman von Kando, described above, and patented. The arrangement of the trucks is due to the Rete Adriatica. The cab and locomotive-frame were designed by the Bureau of Machine Construction (or Engine Construction) of the Hungarian State railroads.

The truck frames are hung to the bearings of the outer driver shafts by jointed suspension-irons.

The cab has side doors, and an additional door at each side of the prow, through which access is had to the railed running-board and by this to the next car. All the electrical equipment except the rheostats are located within the cab; the rheostats are so placed in the shelter boxes in front and behind that the parts requiring inspection are accessible from the cab. The slanting-walled shelter-boxes have round openings at the prow and gill-like ones at the sides, to provide sufficient cooling for the water rheostats by the draft of air while running. On the roof of the cab are fastened the sockets of the trolley, the trolley bases, and two compressed air tanks.



Trolley Base Operated by Compressed Air.

In general the arrangement of the trolley is the same as in the electric vehicles delivered in 1901. The contact roller is unchanged, only the copper cylinders have been replaced by Mannesmann tubes heavily copper electro-plated. The insulating supports of the trolley pedestal are, for greater rigidity, not of porcelain, but consist of a cast-iron shell with "Stabilit" and porcelain lining. The oil-dash-pot, instead of being connected by a chain, is connected to the trolley harp by a bolt with two detents. The air-cylinder of the pedestal is so arranged that the trolley-roller is pressed more strongly to the wires at the higher speed. This arrangement saves the working-conductors and insures good contact at the higher speed. For this purpose two pistons are placed in the air-cylinders, the one acting at the lower speed has a limited stroke; but if the switch at the main air-controller is thrown over to high speed, the second plunger is automatically put under pressure, drives the cross-head at the pedestal farther out and tightens the springs. The trolley, in its lowered position, presses on knife switches which automatically open when it is lowered, thus the lowered trolley is made "dead," nor can it get current from the other trolley through the common conductors. The electrical and compressed air leads are protected from external influences by an iron cap.

The prescribed two speeds are secured by connecting the motors in "cascade" or "single," one high and one low tension machine being united in the same housing. Of such double machines there are two. The concentric arrangement of the motors used in the rolling stock delivered in 1901 had the great advantage that the bearings were not subjected to bearing-stresses. When power is transmitted by connecting-rods, heavy lateral stresses are put on the bearings, but as the gap between ring and armature is only 2 mm. and a change of a tenth of a mm. at most is permissible, provision had to be made to protect the motor bearings from side-thrusts.

The bearings of the armature are therefore built into the shields of the motors, and only the shaft-ends projecting from the housing have a bearing in the locomotive frame. Hence the motor bearings have to carry only the weight of the armature, and so that they may be well lubricated, are built as oil-ring-bearings. Each double motor is hung by four suspension-bolts through eyes in the lower part of the housing, from the locomotive frame, and divided up by their

aid. The housings are firmly screwed up and soldered to keep out moisture and dust.

For easy accessibility, and to gain space for the motor, the slip-rings are placed outside of the frame; thus the ends of the armature winding are brought out through the hollowed-out shaft, the perforated crank and the crank pin through a return-crank to the slip-rings.

The brush-holders are fastened to the frame and are protected by a housing which opens out to both sides. This arrangement permits of inspecting the slip-rings even during a short stop, and even permits of changing them if substitutes are at hand.

The main motor switch is constructed exactly as the early designs, only the twining of the contact-plug disc is not done by hand, but by two little air-cylinders. The main switch, formerly used, outside of the main motor switch, is omitted, and replaced by a magnetic switch in the compressed air leads, which cuts out the main motor switch on a long continued overload of the motors. This main switch does not operate on overloads of short durations. The disc with the contact-plug is actuated by compressed air, and in such a way that an arc cannot be drawn.

The new speed controller differs from the older one in the arrangement of the brushes and knife-contacts and also in that the controller of 1901 was moved by hand, while the new one is worked by compressed air. The contact-blades are fixed and the brushes of thin strips of copper are mounted on a vertically movable rod—this has a plunger at its lower end which moves in a closed cylinder.

The lowest position of the controller corresponds to the lower speed, but if air is admitted under the plunger, the plunger-rod with the brushes is thrust upward; this position is for the higher speed. Since the upper cylinder is constantly connected to the main reservoir, the plunger with the brush-holder is kept in the lowest position. There is only one controller for both motors.

Two locomotives are equipped with water resistances, the third, experimentally, with metallic resistances at the request of the railroad management. The water rheostat differs from the type of 1901 in its development and by an improvement in the distributing valve on the housing. To get as good a cooling as possible, wrought-iron, ribbed, pipes were used, which fill up with water when the rheostat is working and stay full until the short-circuiter cuts out the current from the rheostat; thus the water, heated up in starting, is rapidly cooled when running.

The distributing-valve has the function of controlling the admission of air to the rheostat-box, and provides for the short-circuiting and the rapid fall of the water level on opening the circuit. The distributing valve may be opened from the cab and is easily inspected.

The metallic resistance is built up of corrugated strips of German silver in such a way that they are cooled from every direction. From the individual sections, wires with fireproof insulation run to the controller. The contact-brushes are arranged on the inner surface of a cylinder, the two halves of which are movable about a hinge, being thus easily opened and accessible. The cutting into or out of circuit of the various steps is done by turning a shaft by means of the main air-controller. On the cover of the controller there is a double air-cylinder for cutting out the resistances by compressed air through the master switch. When thus cutting out by means of compressed air, the hand-wheel is carried along, and as this movement is quite sharp, the wheel was made smooth, without projections or spokes.

All the air devices except the trolley are controlled from the main air-controller. A handle controls the little cylinders in the main switch and is used for changing the direction of motion; another handle controls the low tension motor switch and is used for speed control; pushed back it corresponds to the lower speed, forward to the higher. A handle controls the water-rheostats and is used for starting. At standstill the position of this handle is at right angles to the axis of the locomotive and is conveniently handled by the motorman, even if he has to lean out of the window, as in drilling. If he pulls the handle toward himself, then at a displacement of about 12 degrees the main switch is closed, compressed air rushes to the rheostat and cuts it off from the external air. Turning it further lets compressed air rush through the regulating valve into the inner space of the rheostat, the liquid rises and the locomotive starts. A different level of the liquid corresponds to each position of the handle, hence a different current, so the motorman can change the starting current at will. It stays constant as long as the handle is left in one position. The three handles are interlocked The pumps of the first Valtellina cars were valve-pumps, making a most disagreeable noise while running. The new pumps have a rotary slide valve and operate noiselessly.

Tests for Pull.—Tests were made to determine whether the draw-bar pull called for in the specifications can really be attained. For this purpose a test car was put between the locomotive and train. During the measurements, a pull of 9,000 kg. at the draw-bar was repeatedly observed at starting. This amounts to a traction effort at the periphery of the locomotive wheels of 12 tons in round numbers, including the force necessary to start the locomotive, at which value no slipping of wheels was noticeable. Since the weight for adhesion of the locomotive amounts to 42 tons, the coefficient of friction was 0.286.

With one of the motor cars, accurate measurements were made at the power house on the night of April 20, '04, of the current taken during the trip of the car from Lecco to Bellano and back. The performance was as follows:

Consumed watt hrs. for 1 ton km......	36.6
Returned watt hrs. for 1 ton km........	1.8
Difference	34.9

The consumption for 1 useful ton km. on the line Lecco-Bellano amounts to 34.9 watt hours. But this includes the losses of the high tension line from Morbegno to the transformer in Abbadia, which alone was connected up, and of the low tension line Lecco-Bellano.

Besides four canal-men to watch the canals and attend to sluices, the following employes are engaged: In the power house the duty is 18 to 20 hrs. per day and is cared for by three shifts. Each shift consists of an electrician, an engine tender and an oiler; besides there are for the three shifts, one chief engineer and his substitute, or eleven men employed in all in the power station. Three wiremen do duty in inspection and maintenance of line, besides one day laborer at each transformer station, who has helped in stringing the line. These stations are provided with tools and some repair material, so as to be able to make small repairs at once. Each trackman, who has to look after both track and overhead work, carries a note book, the leaves of which consist of two parts; on the inner part (bound in) all the faults are printed that can occur on the line; the outer removable part is used by him to report the location by km. or pole number where he has observed faults. This part he turns in to the nearest station master, who has to see to further action. If the defect is such as would damage the trolley, the crews are informed, so that the place can be passed with trolley down. With proper instruction, the same employes can be charged with supervision of line and track.

The running of locomotives and motor cars is done by one man in each case, who has also been trained in the duties of conductor; thus there are always two officials on each train, capable of running the train in every respect.

On July 10, 1904, the "Società Italiana per le Strade Ferrate Meridionali" took over the whole equipment of the Valtellina line. From that date the operation has been in the hands of that company, after the constructing company, Ganz & Company, had been operating it for a two-year trial. This period of test was not up until October 15, 1904. The fact that the purchasing company reduced this trial by a full quarter of a year, shows that it considers the entire plant and equipment of the road as proved in all parts, and fit for permanent service.

The magnificently designed and appropriately executed undertaking may therefore be said to be a thoroughly successful one, and is looked upon as a model for similar plants, even under less favorable conditions for obtaining current.

Franchise Taxes in New York.

The Supreme Court of the United States has sustained the franchise tax law of New York State, passed in 1899, under which the franchises of public service corporations in cities are taxed the same as real estate. It is understood that the city of New York will at once receive about 24 millions of dollars in taxes which have been withheld by the corporations, pending the litigation, which has now been decided against them. The decision of the court is unanimous, sustaining the New York Court of Appeals. It was prepared by Justice Brewer. Taking up the contentions in the case, Judge Brewer said the main one was that this tax legislation impaired the obligation of contracts. Continuing, he said:

"It must be borne in mind that presumptively all property within the territorial limits of the state is subject to its taxing power. It would not be doubted that if a grant of specific, tangible property like a tract of land and the payment therefor was a gross sum, no implication of an exemption from taxation would arise. Whether the amount was large or small, greater or less, if the payment was distinctly the consideration of the grant, that which was granted would pass into the bulk of material property, and, like all such property, be subject to taxation. Nor would this result be altered by the fact that the payment was to be made annually instead of by a single sum in gross. If it was real estate, it would be equivalent to the conveyance of the tract subject to ground rent, and the grantee taking the title would hold it liable to taxation upon its value. If this be true in reference to a grant of tangible property, it is equally true with respect to a grant of a franchise, for a franchise, though intangible, is none the less property, and oftentimes property of great value. Indeed, growing out of the conditions of modern business, a large proportion of available property is to be found in intangible things like franchises."

Regarding the contention that when the public grants a privilege on condition of the payment of an annual sum, the contract implies that the public shall exact no further payment for that privilege, and that to impose a tax is simply increasing the price which the grantee is called upon to pay for the privilege, Justice Brewer said:

"We are not disposed to undervalue the

force of these situations, but it would be giving them undue significance to hold that they are potent to displace the power of the state to subject to the burdens of taxation property within its limits. The word tax is not infrequently used in a general sense as denoting a burden or charge, and not in a strict legal sense of a charge or burden imposed by the state for the purpose of revenue for its support.

"The language quoted from Section 46 indicates the desire of the legislature to deal equitably with the corporations holding these franchises. Surely the manifestation of this desire cannot be construed into a repudiation of power. These charges are not called taxes, but are spoken of as in the nature of taxes, and the legislature, recognizing the equitable force of the claim based thereon, provided that corporations be given credit for sums thus payable. We are of opinion that no contract right of the relator was impaired by the legislation in question."

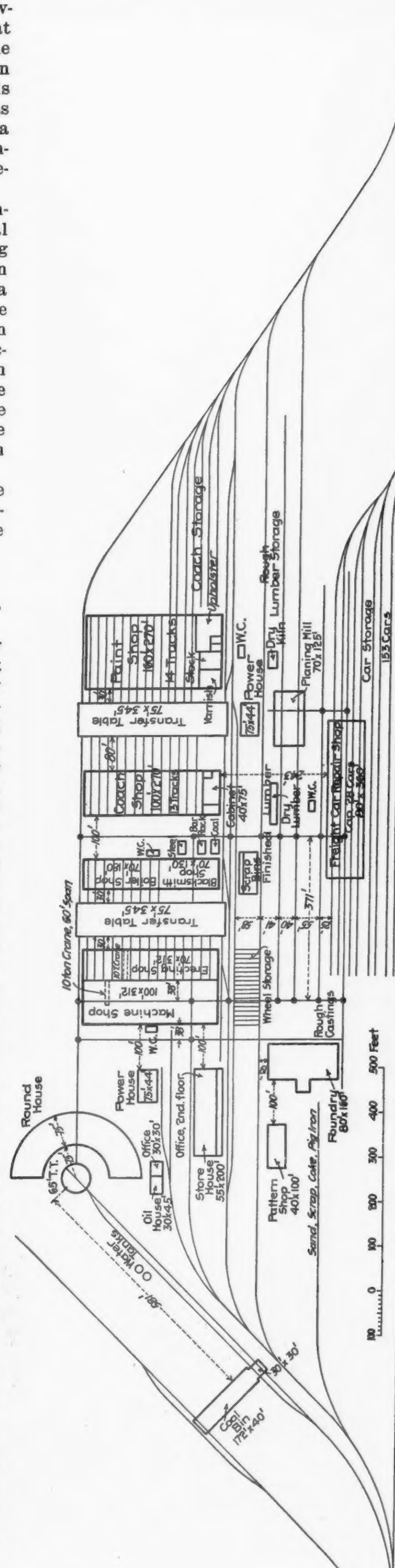
The opinion overruled the point that the tax law denies to the relator the equal protection of the law and due process under the Fourteenth Amendment.

Waycross Shops of the Atlantic Coast Line.

The Atlantic Coast Line is building new shops at Waycross, Ga., which while not exceptional in point of size, are particularly well arranged as will be seen from the accompanying drawing showing the general layout of the tracks and buildings. The locomotive and coach shops are laid out on the transverse track plan with transfer tables, but the freight repair tracks are arranged longitudinally under the shed. The arrangement of all the buildings is compact and yet permits of extensions to any or all of them in the future. There are 12 main buildings, a machine and erecting shop 170 x 312 ft., boiler and smith shop 70 x 310 ft., coach and cabinet shop 100 x 310 ft., paint shop 160 x 310 ft., two power houses each 44 x 75 ft., planing mill 70 x 125 ft., freight car repair shed 80 x 360 ft., foundry 80 x 160 ft., pattern shop 40 x 100 ft., storehouse 55 x 200 ft., and an oil house and office building 30 x 75 ft.

The machine shop occupies 100 ft. of the width of the building, or 143 per cent. of the erecting shop floor space, and the bay next to the erecting pits is spanned by a 10-ton crane which serves the heavy machines. A 100-ton crane spans the 15 erecting pits and does much of the work usually done on the transfer table. The boiler shop floor space is 58 per cent. of the erecting shop space, and the smith shop is 42 per cent., which corresponds to good average practice for modern shops. The transfer table separating the boiler and erecting shop is 75 ft. wide and has a travel of 345 ft.

The coach shop and paint shop are quite large, having 13 tracks under cover, each long enough to hold two cars of ordinary length. Outside of the coach shop a storage space 80 ft. wide has been left between the building wall, and the transfer table pit to store cars waiting to be put through the paint shop. Additional coach storage tracks are provided beyond the paint shop, all leading to the main shop track. The planing mill, lumber storage and dry kilns are located between the coach shop and the freight repair tracks, convenient to both and close to the power house. There are four tracks under cover for freight repairs having a capacity of 28 cars, and in the open there are eight tracks having a total storage capacity of 153 cars. Each building is connected with all of the others by a system of standard gage shop tracks having turntables placed at the



Plan of Atlantic Coast Line's New Shops at Waycross, Ga.

intersections. The material used in any shop is stored conveniently near and little or no rehandling or long haul is necessary. This is one of the best and most complete layouts for a moderate size shop which we have seen.

We are indebted to Mr. R. E. Smith, General Superintendent of Motive Power, for the drawing.

Locomotive Performance Under a Steam Pressure of 250 Pounds.

An Investigation Conducted Under the Patronage of the Carnegie Institution.

BY W. F. M. GOSS.

In the development of the modern locomotive, there has been a gradual but steady increase in steam pressures. From the 30 or 40 lbs. which served in the early days the pressure has now increased to 200 lbs. and more. Whether the future development of the locomotive is to be marked by a further increase of pressure is a matter of more than ordinary concern. It is a matter which interests the student who approaches it wholly from an academic point of view because of its intricacies as a problem, and it appeals to the engineer because of its practical significance.

High steam pressure does not necessarily imply high power. The two things are in fact only indirectly related. The forces which are set up by the action of the engine are as much dependent upon cylinder volume as upon boiler pressure, and when the pressure is once determined the latter may be designed for any power. It should not be forgotten, however, that anything which makes the engines of a locomotive more economical in their use of steam, will, when the limit of boiler capacity is reached, permit the development of more power. If high steam pressure promotes economy in the use of steam, it becomes an indirect means for increasing power. The argument in favor of higher steam pressures must, therefore, concern itself with the effects produced upon the economic performance of the engine. Information which will serve in determining the value of such effects are meagre. One road which has been operating locomotives at a pressure of 200 lbs. has recently fixed upon a pressure of 185 for new equipment, while another road, whose past record has been similar, has ordered new locomotives which will carry 210 lbs. In view of these facts, and with the hope of ascertaining a logical basis from which to determine what the steam pressure of a simple locomotive should be, it was determined to undertake an experimental study of the problem upon the testing plant of Purdue University.

A few experiments involving the use of different steam pressures in locomotive service were made at Purdue as early as 1895, but as the boiler of the locomotive then upon the testing plant was not capable of withstanding pressures greater than 150 lbs., these early tests were of limited scope. The matter was, however, regarded as of such importance that in designing a new locomotive for use upon the plant, a pressure of 250 lbs. was specified; a limit which then was and still is considerably in advance of practice. Thus equipped, an elaborate investigation was outlined involving a series of tests under six or eight different pressures, those for each pressure representing a sufficient number of different speeds and cut-offs to entirely define the performance of the locomotive. But the expense of operating the locomotive under very high steam pressures was far greater than was anticipated so that with the limited funds which could be devoted to maintenance, in combination with

the demands of large numbers of students requiring instruction, the operation of the laboratory was necessitated under conditions which were more easily maintained. For this reason, progress in the solution of the general problem affecting pressures was for a time slow, and it was not until 1904, when a grant of a considerable amount was received from the Carnegie Institution, that the undertaking could be vigorously pushed. It is now expected that the whole work of the laboratory will be finished early in the present summer, and that final publication will soon follow.

In anticipation of this publication, it will be of interest briefly to review some of the results obtained when operating with a full open throttle under a pressure of 240 lbs. Certain of these are given in Tables I and II.

TABLE I.

Steam per I. H. P. per hour.				
Miles, per hour.	Revolutions per minute.	Cut-off, per cent. of stroke 15.	20.	27.
20	97	26.29	25.33	24.08
30	146	25.48	24.44	.....
40	195	24.16	23.86	.....
50	244	24.97	.....	.....

TABLE II.

B. T. U. per I. H. P. per Minute				
Miles, per hour.	Revolutions per minute.	Cut-off, per cent. of stroke 15.	20.	27.
20	97	442.3	425.8	405.5
30	146	424.9	407.4	.....
40	195	405.9	398.0	.....
50	244	418.1	.....	.....

Values thus grouped show the full range of operation for the experimental locomotive under the pressure stated, with a wide open throttle. Thus, it is possible to operate at 40 miles an hour under a 20 per cent. cut-off, but an attempt to run a test at 50 miles an hour with the same cut-off failed through the inability of the boiler to supply steam. Similarly, under a 27 per cent. cut-off, it is possible to run at a speed of 20 miles, but an attempt to run at 30 miles failed. The tests representing an approach to maximum conditions were attended by the development of from 500 to 575 indicated horse-power, which is a heavy load for a locomotive having cylinders but 16-in. x 24-in., and a boiler of but 1,322 ft. of heating surface.

With reference to the economical results, it appears that the average steam consumption under eight different conditions of running is 24.57 lbs. per h.p. per hour, the best value being 23.86. From tests previously run, it is known that the performance for 180 lbs. pressure is 24.08 lbs., from which it appears that the performance for 180 lbs., when compared with that at 240 lbs., presents a difference of but .22 of a pound; a difference too small to constitute a strong argument in favor of the higher pressure.

A more careful study of all the data obtained indicates that further increase of pressure in locomotive service is not desirable, and strongly suggests the possibility that even present-day practice may exceed limits which in the end will be found most economical.

It is well-known that theoretical considerations show that the gain in economy to be secured from increasing steam pressures above 180 lbs. is at best small and the experimental facts which have been quoted indicate that in practice there is failure to realize all that theoretical considerations promise. The reason for this is to be found in the practical difficulties to be met in maintaining all parts of a locomotive tight under very high steam pressures. A boiler leak, either of steam or water, so slight as to attract little attention may easily amount to 100 lbs. or more per hour. A few such leaks materially impair the performance of the locomotive. The data of many tests have been entirely abandoned because of the existence of some conditions which upon the road would have attracted no attention, but which in the laboratory have been regarded as sufficient in their effect to entirely vitiate the results of the tests. Notwithstanding the fact that tests were run on alternate days only, leaving time for boiler-makers and machinists to do their work, it was found impossible to keep the boiler perfectly tight or to prevent entirely the appearance of steam at the glands and drips about the cylinders. When it is remembered that this statement applies to a locomotive in the laboratory where it could be well cared for, it is not difficult to surmise the significance of such leakage as occurs from a locomotive on the road. Moreover, the benefits to be derived from higher pressure can only appear when the locomotive is working, while a portion of the leakage proceeds throughout the period during which it is under steam.

It was found, also, in running tests at 240 lbs. that minor difficulties constantly presented themselves. For some of these, feed-water was responsible. The water used at the laboratory is from a driven well and contains some lime and magnesia. When used in stationary boilers carrying moderate pressure, it does not ordinarily form a hard scale but deposits a sludge which may be easily washed from the boiler. Its use for six years in the boiler of Purdue's earlier locomotive (Schenectady No. 1), for which the safety valve was set at the low pressure of 140 lbs., resulted in the formation of very little scale. During this period, a year or two elapsed between the visits of a boiler-maker, and the boiler was perfectly tight practically all of the time. With this satisfactory record, when using low steam pressure, it is significant to note that the present locomotive (Schenectady No. 2), using the same water but carrying a higher steam pressure, has required the frequent attention of a boiler maker. After 30,000 miles running, new side sheets were inserted, and the leakage of tubes and stay-bolts have been of constant occurrence. It appears certain that the presence of solids in the feed-water which at the lower pressure gave little trouble, has seriously affected the operation of the plant at higher pressures.

In addition to boiler defects there has been constant trouble with injectors and check valves. The injectors employed, while especially designed for the high pressure service, fill up very rapidly, due doubtless to the high temperature of the water delivered. It has been the practice when operating at 240 lbs. to clean the injectors between each run, but even under these conditions, tests have been lost through the failure of both injectors. It has been found that injector tubes will fill with lime so rapidly as to become inoperative after an hour's run, and check-valves which have been clean at the beginning of a test have filled so that they would not close in the course of a single test. The fact seems to be that much of the solid matter which at lower pressure goes through the injector and passes the check into the boiler, is, under very high steam pressure, deposited in the injector and feed-pipe.

In view of these difficulties, it was finally determined to improve the feed-water. This was done by drawing water from a cistern receiving return from the heating coils of the laboratory building from which source it was possible to obtain from two-thirds to three-quarters of the total feed needed. The change greatly increased the certainty of operation though even the small amount of raw water then used manifested itself in the injectors and check valves, which still required to be cleaned after every test. It is in fact quite likely that a determination of the most desirable steam pressure for locomotive service, must depend not only upon the economical performance of the engines and boiler but also upon the purity of feed-water supply. In our western country, where feed-water necessarily contains a considerable amount of solid matter, it will be found that the difficulties in maintaining and operating a boiler multiply with each increment of pressure.

While a more precise statement of conclusions must await the full development of the present research, it may safely be said that an attempt to increase beyond limits now common the steam pressure upon American locomotives can only lead to disappointment. The possible gain is small and is likely to be more than neutralized by increased leakage while the difficulties of maintenance and operation multiply. It is not improbable that the final results will show that 200 lbs. which is a generally accepted standard of to-day is in our western country too high for best results.

Railroad Shop Tools.

(Continued.)

LATHES.

The accompanying illustration, Fig. 1, shows a 90-in. Niles driving wheel chucking lathe made by the Niles-Bement-Pond Company, New York. This machine is probably the most powerful machine of its type ever made, its weight being something over 110,000 lbs. It was designed for taking two cuts ½ in. deep with a $^3/_{16}$ in. feed at a speed of 20 f.p.m., but in actual practice it has exceeded these figures. It will turn six pairs of driving-wheel tires per day of 10 hrs. This is remarkable when it is considered that

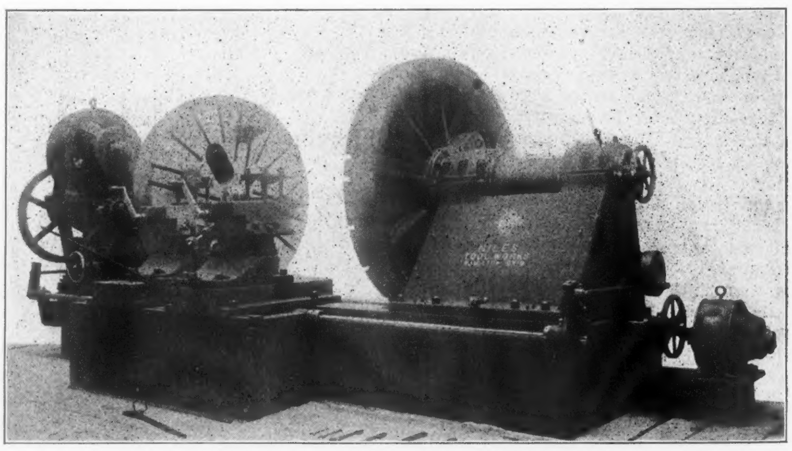


Fig. 1—Niles-Bement-Pond 90-in. Wheel Lathe.

the best time on the older types of machines is an average of hardly more than two pairs per day and even now in many shops it takes from 6 hrs. to 8 hrs. to turn one pair of

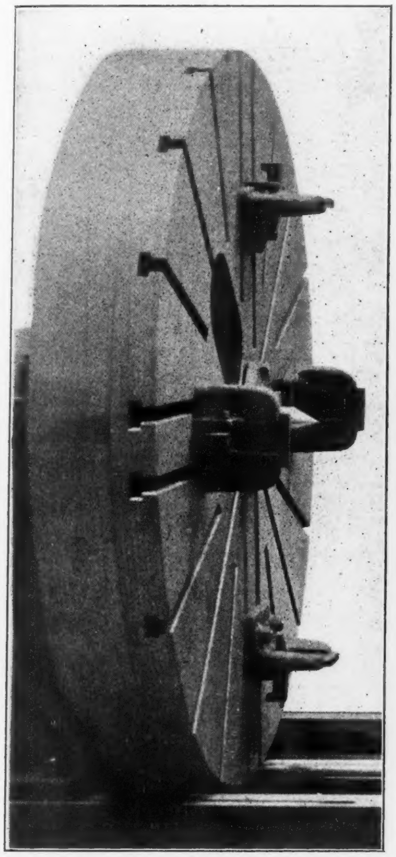


Fig. 2—Face Plate of 90-in. Driving Wheel Lathe Showing "Sure Grip" Driver.

tires. One of the principal features of the machine, aside from its massiveness, is the method used for holding the wheels. As shown in Fig. 2, four "sure-grip" drivers are mounted on each face plate. The wheels are bolted firmly against these drivers and the

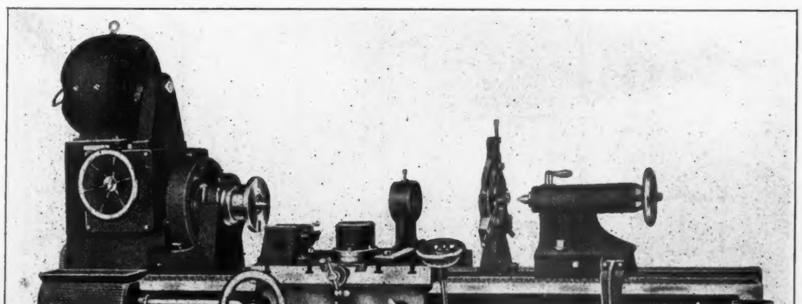


Fig. 4—The Hendy 24-in. Lathe as Fitted with Crocker-Wheeler Drive.

wedges of the drivers are driven up, thus forcing the saw teeth of the drivers directly into the tires. Thus secured, the driving wheels are held perfectly rigid under the heaviest cuts. In order to provide for the quick removal of wheels, an independent motor is furnished for traversing the movable head of the machine. The largest wheels can be put in the lathe and chucked ready for turning in from 10 to 15 minutes. The toolrests are of very heavy design and are mounted on swivel bases. The feed mechanism is easily controlled by the operator, and the face plates are driven by internal gears and are provided with openings for the crank pins, so that the wheels can always be chucked close to the face plates. The principal dimensions of the machine are as follows: Distance between face plates, 6 ft. 8 in. to 9 ft.; swing over bed, 92 in.; diameter of face plates, 90 in. Wheels from 50 in. to 84 in. in diameter can be turned without having to change the position of the carriages. The main driving motor is a 40 h.p. Westinghouse type "S" motor, having speed variations from 490 to 980 r.p.m., which gives when combined with the gear changes a total range of cutting speeds of from 10 ft. to 25 ft. per min. on all diameters of wheels from 48 in. to 84 in. A 5-h.p. Westinghouse type "S" motor of 1,050 r.p.m. is used for traversing the movable head. The machine was exhibited at the Railway Appliance exhibit in Washington, where it attracted considerable attention.

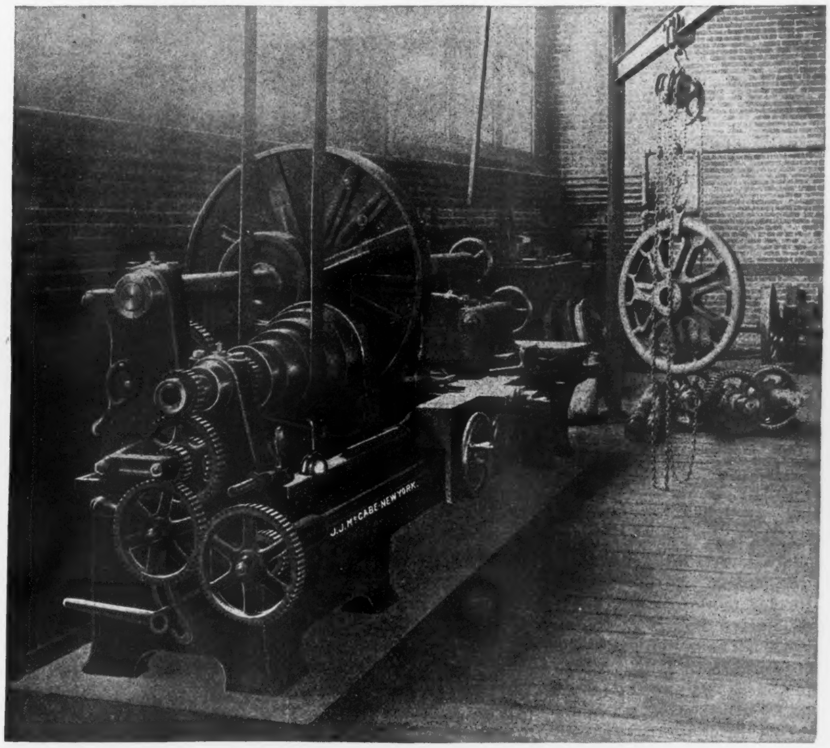


Fig. 3—McCabe's Double-Spindle Lathe.

A combined 28-inch and 48-inch lathe, made by the J. J. McCabe Company, New York, is shown in Fig. 3. This machine is similar in construction to any standard 48-inch lathe, but has, in addition, extra facilities for 26-inch swing work, there being double head and tail stocks. The large face plate is fitted with internal gears having a ratio of 72 to 1. This gives the machine ample power for turning and boring driving wheels and other heavy work up to 48 in. in diameter. A special attachment is fitted to the large faceplate for turning driving wheels. This extends the center so that the crank pins will clear the face plate. This machine is especially desirable where floor space is limited, as in roundhouses, etc. When the large face-plate is not in use it can be removed and the machine can be operated as an ordinary 28-inch lathe. This type of machine is made with beds measuring from 10 ft. to 40 ft. A number of these lathes are used in railroad shops and roundhouses throughout the United States as well as in Europe. The illustration shows a lathe of this design in the shops of the Western Ohio Railway at Wapakoneta, Ohio. In these shops wheels have been centered, faced and bored on this machine in 55 minutes. In all cases the wheels were bored from a 4½-in. sand core to 5 in.

The 24-in. Hendey-Norton lathe shown in Fig. 4 is made by The Hendey Machine Company, Torrington, Conn. The lathe, as shown, is fitted with a 2¾-h.p. Crocker-Wheeler motor geared to the spindle through a silent chain drive. This as direct and the two back-geared combinations give three spindle speeds from any one motor speed. The controller handle is attached to the right side

of the carriage and is geared to a splined rod which is connected to the controller and which runs the full length of the bed. Thus the operator can change the speeds without leaving his work. The proportion of the gearing in the head is 11⅜ to 1. The front spindle bearing is 3¾ in. in diameter by 6½ in. long, and the back bearing is 2⅞ in. in diameter by 5 in. long. A 1¾-in. hole passes through the entire length of the spindle. The tail spindle is 2⅝ in. in diameter and the length of the carriage bearing on the bed is 31 in. The feed is arranged so as to cut from 6 to 288 per inch and threads from 1 to 48 per inch can be cut with the machine. This machine is made with bed lengths from 7 to 24 ft.; the 10-ft. bed takes 5 ft. 4½ in. between centers. The maximum swing over the carriage is 15½ in. A taper attachment is furnished when ordered. This will turn 20 in. in length and is arranged to give an angle of 15 deg. Both ends are graduated, one in degrees and the other in inches. The weight of this machine is about 5,000 lbs.

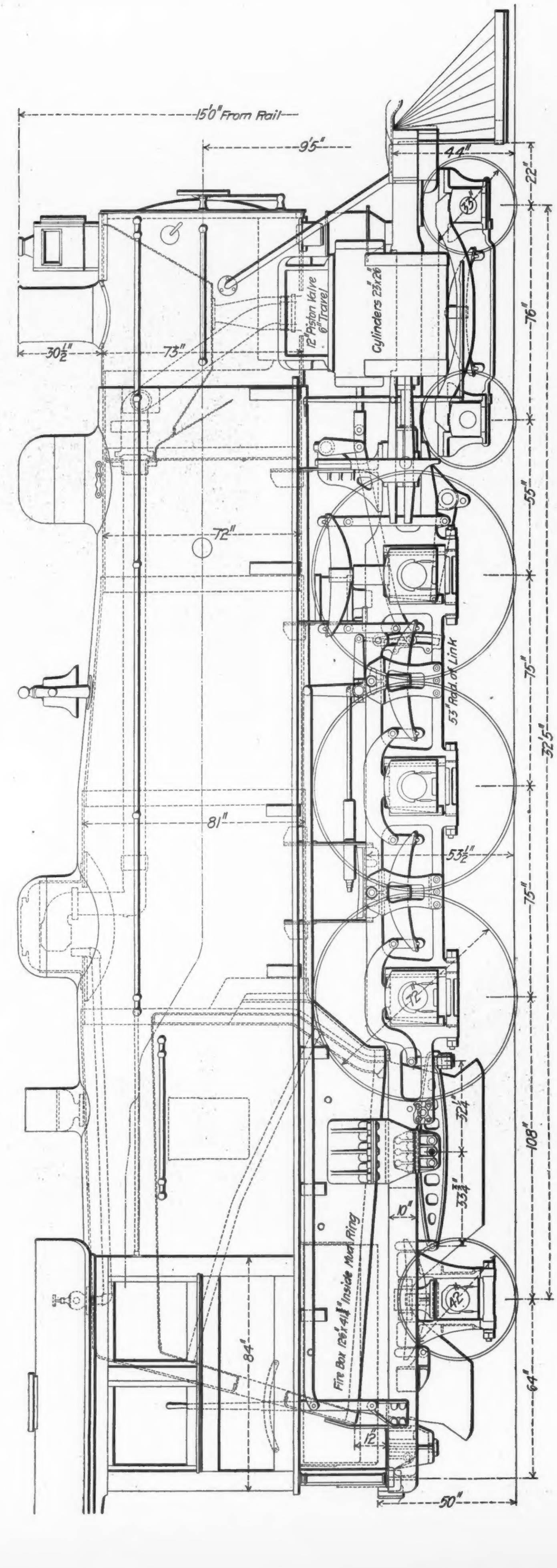
(To be continued.)

Heavy Passenger Locomotives for the C., M. & St. P.

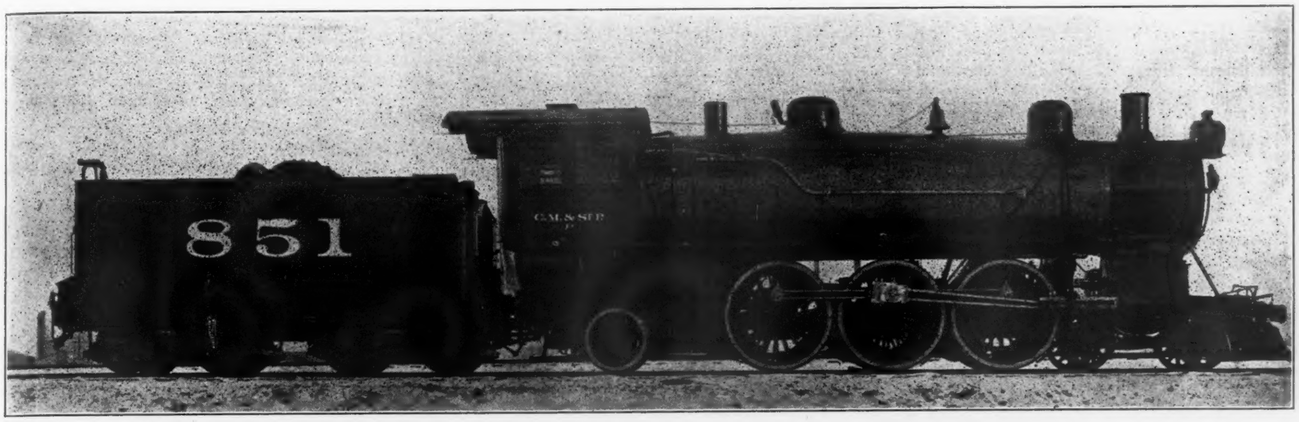
The Chicago, Milwaukee & St. Paul has just placed in service some heavy Pacific type passenger locomotives which were designed and built at its West Milwaukee shops. Preliminary to the preparation of this design certain conditions to be conformed to were laid down by Superintendent of Motive Power A. E. Manchester, as follows: The weight per wheel should not exceed 23,500 lbs. The locomotive should have piston valves and the length of stroke should be 26 in. The length of flues should not exceed that of the road's Atlantic type engines —16 ft. 6 in. In view of the satisfactory service in life of firebox and in fuel consumption from narrow firebox locomotives, this boiler should have a narrow firebox; also the fireman should not have to throw the coal over 10 ft. The depth should be greater to compensate for the reduced width.

Detail drawings are shown herewith. The boiler is 72 in. in diameter and has 3,381.6 sq. ft. of heating surface. The firebox is 10 ft. 5⅛ in. long, 3 ft. 5⅛ in. wide and 5 ft. 10½ in. and 7 ft. deep. The grate area is 35.84 sq. ft. It will be noted that the length of firebox is in excess of 10 ft. However, the position of back head and firebox are such that the actual distance coal must be thrown is less than the prescribed limit of 10 ft. The depth at the throat sheet, it will be noted, is 28½ in. The details show the front-end arrangement. The smoke-box is 97 in. long, the distance from front flue sheet to center of nozzle being 51 in.

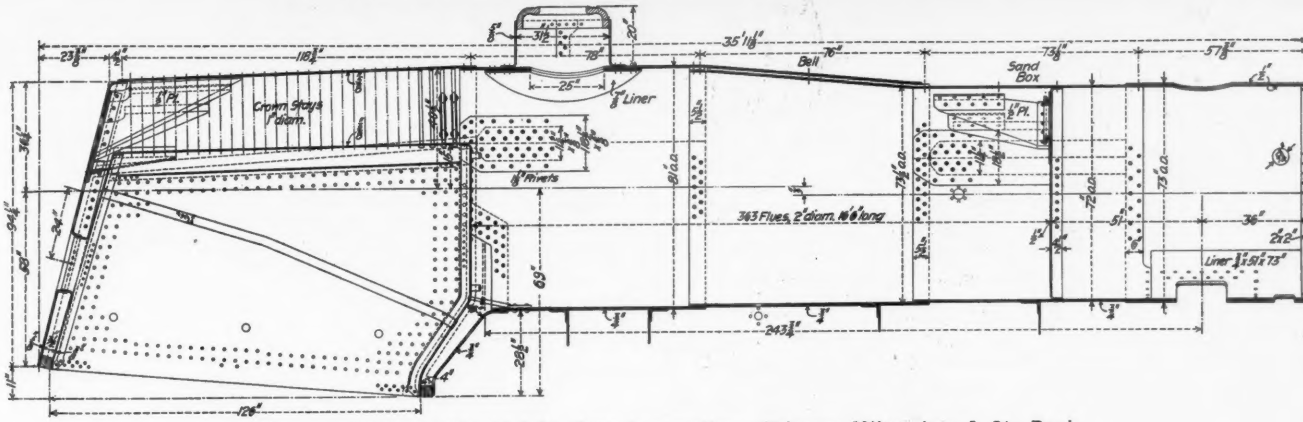
The cylinders are 23 in. x 26 in., giving a tractive effort with 200 lbs. boiler pressure of 32,475 lbs., and a ratio of tractive weight to tractive effort of 4.37. In general dimensions these locomotives compare quite closely with the Chicago & Alton Pacific type locomotives, which are the heaviest in the world in passenger service. Although having less total weight, the weight on drivers is slightly greater. Another difference to be noted is in the cylinder dimensions, the Alton engines being 22 in. x 28 in. The reason for the larger diameter in the St. Paul engines is based on compound practice, with which kind this new design must compete. As the feature of admitting high-pressure steam to the low-pressure cylinders when working on grades gives the latter greater tractive power for weight on drivers, a similar relation was observed for the simple engines. The total weight divided by heating surface is 64.5 in the St. Paul loco-



Side Elevation of Heavy Pacific (4-6-2) Type Locomotive—Chicago, Milwaukee & St. Paul.



Heavy Pacific (4-6-2) Type Locomotive—Chicago, Milwaukee & St. Paul.

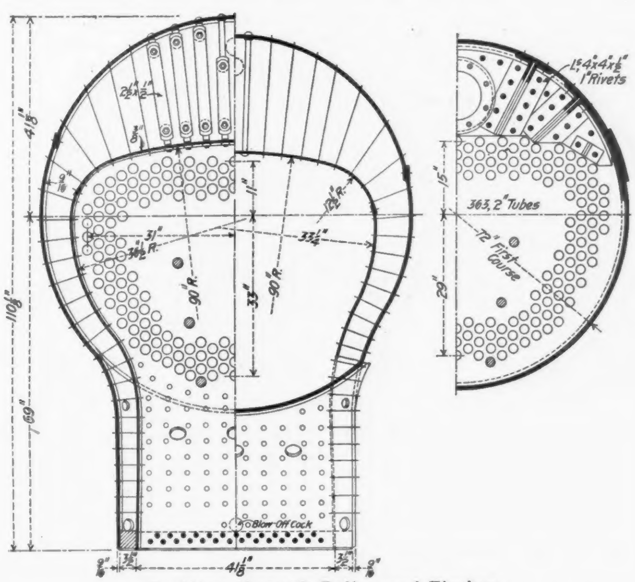


Boiler for Heavy Pacific (4-6-2) Type Locomotive—Chicago, Milwaukee & St. Paul.

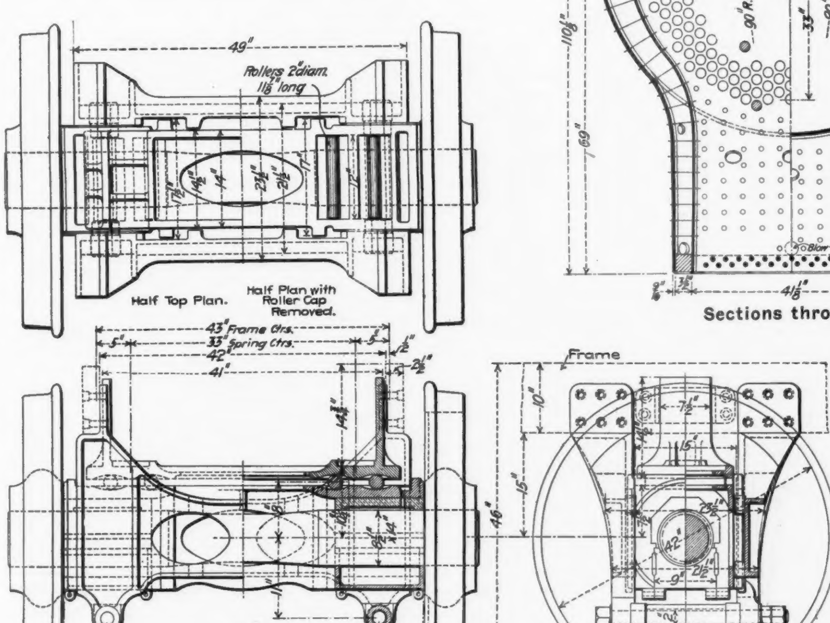
motives; but the reduced length of tube makes a large number necessary, there being 363 against only 245 in the latest Alton design, in which the ratio of total weight to heating surface is 72.5.

The conditions governing the design of the present locomotive made necessary the introduction of some new features in equalizer and trailing truck construction. Drawings of the latter are shown. The design was worked out by Mr. J. F. De Voy, Mechanical Engineer. The general dimensions follow:

Type	4-6-2
Weight on drivers	142,000 lbs.
" total	218,000 "
" engine and tender	343,600 "
Wheel base, total, of engine	32 ft. 5 in.
" " driving	12 " 6 "
" " total (eng. & tender)	59 " 11 7/16
Length over all, total, eng. and tender	75 " 5 in.
Height, center of boiler above rails	9 " 5 "
Height of stack, above rails	15 ft.
Heating surface, firebox	245.6 sq. ft.
" " tubes	3,136 "
" " total	3,381.6 "
Grate area	35.84 "
Drivers, diameter	72 in
Front truck wheels, diameter	33 "
Rear truck wheels, diameter	42 "
Journals, driving axle, size	9x12-in.
Main crank-pin, size	7½x4¾-in.
Cylinders, diameter	23 in.
Piston, stroke	26 "
Steam ports, width	1⅝ "

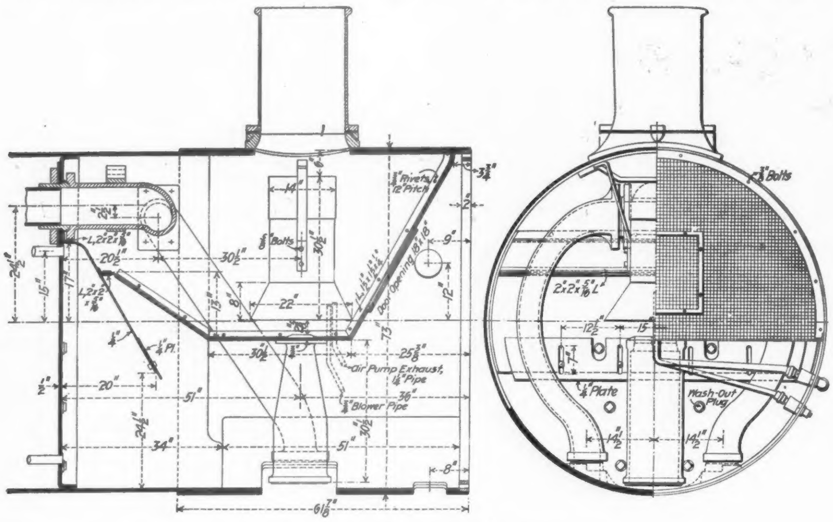


Sections through Boiler and Firebox.



Details of Trailing Truck.

Exhaust ports, width	2½"
Bridge, width	1⅛"
Valves kind of	Piston
" greatest travel	6 in
" outside lap	1-in.
" inside clearance	⅛-in.
Boiler, type of	Ext. wagon top.
" working steam pressure	200 lbs.
" thickness of material in barrel	¾-in.
" diameter of barrel	72 in.
Crown sheet stayed with	Radial stays



Details of Front End Arrangement.

Firebox, length	10 ft. 5⅛ in.
" width	3 " 5⅛ "
" depth front	5 " 10½ "
" depth back	7 " 0 "
Tubes, number	363
" outside diameter	2 in.
" length over sheets	16-ft. 6 in.
Tank capacity for water	7,000 gals.
Coal capacity	10 tons.

Program for the Master Mechanics' Convention.

The thirty-eighth annual convention of the American Railway Master Mechanics' Association will be held at Manhattan Beach, N. Y., June 14, 15 and 16. Headquarters of the convention will be at the Oriental Hotel. The following program has been arranged:

OPENING SESSION.
WEDNESDAY, JUNE 14, 1905.
9.30 A.M. TO 1.30 P.M.

Prayer	9.30 a.m. to 9.35 a.m.
Address of President	9.35 a.m. to 10.00 a.m.
Intermission	10.00 a.m. to 10.05 a.m.
Action on minutes of last meeting	10.05 a.m. to 10.10 a.m.
Report of Secretary	10.10 a.m. to 10.20 a.m.
Report of Treasurer	10.20 a.m. to 10.25 a.m.
Assessment and announcement of annual dues	10.25 a.m. to 10.30 a.m.
Election of Auditing Committee	10.30 a.m. to 10.35 a.m.
Unfinished Business	10.35 a.m. to 10.40 a.m.
New Business — Consideration of matters affecting the Association; appointment of committee on correspondence, resolutions, nominations, obituaries, etc., and such other business as may be presented	10.40 a.m. to 11.00 a.m.
Discussion of committee report on: Proper loading of locomotives. — What should be the practice underlying the proper loading of locomotives on the basis of conducting transportation with the greatest efficiency and at least cost, considering all the factors individually	10.00 a.m. to 11.30 a.m.
Discussion of committee report on: Locomotive tests of the Pennsylvania Railroad at the St. Louis Exposition, giving results of tests made	11.30 a.m. to 12.00 m.
Topical Discussions: 1. Best known dimensions for water space around fire-box to produce minimum consumption of fuel and replacement of fire box sheets, and reasons for same? To be opened by Mr. Lawford H. Fry, Baldwin Locomotive Works	12.00 m. to 12.30 p.m.
2. Locomotive Stokers. To be opened by Wm. Garstang	12.30 p.m. to 1.00 p.m.
Discussion of Individual paper by Mr. H. H. Vaughan, The Value of Superheated Steam for Locomotive Work.	1.00 p.m. to 1.30 p.m.
Adjournment.	

MIDDLE SESSION.
THURSDAY, JUNE 15, 1905.
9.30 A.M. TO 1.30 P.M.

Discussion of committee report on: Locomotive driving and truck axles and locomotive forgings which submits the specifications for these parts considered by the International Railway Congress	9.30 a.m. to 10.00 a.m.
Discussion of committee report on: Shrinkage allowance for tires.—To consider whether the present allowance of 1-80 inch per foot is sufficient for large diameter wheels with cast-steel centers	10.00 a.m. to 10.30 a.m.
Discussion of committee report on: Motive power terminals. — To consider: (a) What can and should be done to reduce locomotive terminals to the basis of a machine for treating and handling engines, apart from the question of housing, the object being the prompt handling of power, greater efficiency in service and less detention at terminals, while affording more time and better facilities for care and repair of engines? (b) The best method of heating and ventilating roundhouses	10.30 a.m to 11.00 a.m.
Discussion of Individual Paper by Mr. Geo. M. Basford. The Technical Education of Railroad Employees: The Men of the Future	11.00 a.m. to 12.00 m.
Topical Discussions: High Speed Steel. To be opened by Mr. J. A. Carney	12.00 m. to 12.30 p.m.
Staybolts	12.30 a.m. to 1.00 p.m.
Discussion of committee report on: Flexible Staybolts.—To consider the subject of flexible staybolts, number in use, manner of applying and service rendered	1.00 p.m. to 1.30 p.m.
Adjournment.	

CLOSING SESSION.
FRIDAY, JUNE 16, 1905.
9.30 A.M. TO 1.30 P.M.

Discussion of committee report on: Water softening for locomotive use. — The practicability of water softening for locomotive use by means of chemicals or the application of heat, and the maximum cost per one thousand gallons permissible, that the expenditure could be recovered in reduced motive power expenses	9.30 a.m. to 10.00 a.m.
Discussion of committee report on: Time service of locomotives.—To consider the average engine hours locomotives are in service, in shop under repairs or waiting to get in shop, per annum and the percentage of total time locomotives are actually in and out of service per annum	10.00 a.m. to 10.30 a.m.
Discussion of committee report on: Shop layouts.—To recommend shop layouts for roads having 350, 500, 750 and 1,000 locomotives	10.30 a.m. to 11.00 a.m.
Discussion of individual paper by Mr. C. B. Young, on: (a) Proper Lubrication of Valves when Drifting. (b) Relative Setting for Piston and Slide Valves	11.30 a.m. to 12.00 m.
Topical Discussions: Relief and By-pass Valves for Locomotives. To be opened by Mr. A. E. Manchester	12.00 m. to 12.30 p.m.
Are Engines with Self-Cleaning Front Ends Satisfactory? To be opened by Mr. E. W. Pratt	12.30 p.m. to 1.00 p.m.
Discussion of committee report on Subjects	1.00 p.m. to 1.05 p.m.
Correspondence and resolutions	1.05 p.m. to 1.10 p.m.
Election of officers	1.10 p.m. to 1.30 p.m.
Adjournment.	

Electricity on Steam Railroads.

The Western Railway Club paper on this subject by Mr. Clement F. Street, was printed in the *Railroad Gazette*, April 28. The discussion at the May meeting of the club brought out some interesting information. Prof. Goss, referring to the statement in the paper that the electric locomotive will deliver a horse-power at the drawbar for an expenditure of 3 lbs. of coal an hour, said that this was probably the best performance we could expect for electric traction. An average good performance for steam locomotives is 4 lbs. of coal per horse-power hour, but this will vary as the quality of coal changes and the characteristics of the locomotive improve. Some results recently obtained and later to be published, show that the modern large locomotive using coal of a superior quality can be depended upon to deliver a horse-power at the drawbar for one hour on an expenditure of something less than 4 lbs. of coal under all ordinary conditions of running, at high speed and low speed, at cut-offs which are rather long and cut-offs which are rather short. The consumption seldom exceeds 4 lbs., and is between the limits of 3 and 4 lbs. for simple locomotives. It was also shown that with the modern compound locomotives, it is possible to lower this consumption of fuel to between the limits of 2 and 3 lbs. The minimum consumption shown by several tests

under conditions of running which varied, was about 2½ lbs. per horse-power per hour. When it is stated that the electrical machine will give a horse-power per hour on 3 lbs. of coal it is interesting to know that the modern locomotive of the highest type will do even better than that.

Mr. Geo. A. Damon, of the Arnold Company, admitted that the electrical fraternity has been slow in grasping the problems that are involved in the application of electricity to the operation of trains. He said that ten years ago the best that the electrical engineer had to offer to the steam railroad officer was the direct-current system. This necessitated building power plants along the line of road about every 20 miles. Equipping these lines with the third rail and these numerous power plants, putting on electric locomotives, etc., involved an investment of $20,000 to $25,000 per mile. It is unnecessary to say that the saving effected by the adoption of electricity under these circumstances would not justify such an investment.

It was in 1897 and 1898 that the Arnold Company developed and adopted apparatus and built the Chicago & Milwaukee electric road and some other lines. Alternating current was used with transmission lines taking the current to sub-stations about 8 miles apart, containing rotary converters. This plan was adopted against considerable opposition but it worked very successfully. It was the first road to adopt that type, which has now become almost universal. At about that same time his company was asked to make a report on the feasibility and expense of equipping 180 miles of one of the western railroads. This road was fortunate in having water power at about the center of the line, and things looked very favorable for the electrical equipment of that branch, because equipping it upon this new system of alternating current distribution, that is, taking the current to the sub-station with d. c. distribution from each of the sub-stations, figured up to about $15,000 a mile. But in spite of the fact that this road had the water power at about the center of the line, so that the item of fuel would be eliminated, it still lacked sufficient ton miles in its traffic to justify the change, and the project was dropped.

In working this out, however, they became thoroughly convinced that the rotary converter scheme with a. c. power plant was an illogical one and not a system that would solve the problem of electrical equipment of steam railroads. There is first the loss in the engine, then the loss in the generator, loss again in the transformer, loss in the line, loss in the rotary converter, in the storage battery, in the system of distribution and in the motor, before we finally get to the drawbar. The result is that there is an efficiency (or an inefficiency) of about 50 per cent. and about 6 lbs. of coal per horse-power hour are needed, showing that there would not be a saving in electric equipment that would justify the investment of $15,000 a mile.

Mr. Arnold soon came to the conclusion that the only hope for the electrical engineer would be the adoption of a high-tension conductor and the use of a single-phase a. c. motor. This was in 1899 and was therefore prior to the development of any single-phase motor in this country. In fact, when the attempt was made to get equipment for such a road, the manufacturers, who had all their resources taxed to supply the demand for d. c. apparatus, almost unanimously refused to consider the proposition and considerable objection was raised to it from all sources. There remained only one way to show that the scheme was a good one. The Arnold Company accordingly took the contract for 20 miles of road to be equipped with the single-phase motor when there was not a single-phase motor in sight. The motor was finally developed, all obstacles were overcome, and the first trip was made over the road in June, 1903. While it was not altogether successful it has the record for being the first single-phase motor in the country to be operated under a locomotive in regular service. The voltage of the trolley used at that time was 6,000 volts.

This company recently made estimates on the cost of equipping 100 miles of steam railroad in Canada. It was shown that a road of moderate demands and single track can be equipped with this new single-phase system for about $10,000 per mile. Although the cost of equipping roads has now been reduced quite materially, the electrical engineer still has to show an economy sufficient to justify the installation. In making the analysis for this new road the following plan was used: A curve was drawn showing the cost of operating the road electrically; this curve was rather high when the ton mileage was low, and increased quite rapidly as the ton mileage increased. This peculiar characteristic of the curve was due to the $10,000 investment, which was taken as a basis to figure interest on the investment, depreciation at 10 per cent., etc. At $10,000 a mile for a few thousand ton miles it makes a high figure for the cost of ton miles; but by distributing it over a sufficient number of miles it becomes in time a negligible quantity. The cost of operating with the steam locomotive gives a different sort of curve, almost a straight line, and by putting the two on paper there is a point where they cross.

This Canadian road has water power and has an excellent chance, on account of the construction of the Grand Trunk Pacific, of having considerable ton mileage within the next two years. The critical point shown by the intersection of the curves is well within sight and appears to be so well within the range of possibilities that there may be other roads that could be equipped, provided they have the ton mileage. The use of water power will eliminate the item of fuel, which is large on account of the high cost of fuel. This latter makes the cost of operating by steam locomotives higher than usual and the critical point would therefore be much nearer to the zero line.

This company is also figuring on the electrical equipment of the Port Huron tunnel of the Grand Trunk. The road expects incidentally to save considerable money by putting in electrical equipment, although the primary reason is to get rid of the gases in the tunnel.

It is found that the capacity of the tunnel can be increased about 33 per cent. merely by running the trains a little faster. At the present time the maximum capacity of the tunnel is about three trains an hour, which is an average all-day capacity. With electricity there will be no trouble in running four trains an hour. Also, the better application of the power to trains will be very well illustrated. If the a. c. motor is used there will be the advantage of the speed control of the motor, as the new a. c. motor allows of a very easy method of speed control. The limiting factor will be the strength of the draft rigging on the cars, which taken at 50,000 lbs. will govern the amount of tonnage that can be moved with one motor. But there is no reason why two motors cannot be used at the same time and double the tonnage in a train.

In regard to reduction in operating expenses, there will be one central power plant which will be very economical because steam turbines will be used and the plant will be located on the river to get the full benefit of condensers. There will therefore be one economical power plant instead of three or four locomotives that are under full load only about three or four minutes in every 20 minutes, and the rest of the time are either coasting down hill or standing on the side track, but all the while using coal. It is also intended to use in the power plant a thermal storage system, increasing the boiler capacity. When the load is not on, it will be heating up water ready to make steam at the time of heavy demand. Further economy is therefore expected from this arrangement.

Reduction of cost of maintenance of equipment is expected to be quite material on account of the fact that the electric locomotives will not require the roundhouse attention or repairs that are required by the steam locomotive, because at the present time this cost on the tunnel engine is very high.

Whether a. c. or d. c. will be used has been quite a problem and the analysis of that question will be of considerable interest. It has finally come down to the question of whether or not to use a high tension trolley wire overhead, or the third rail along the ground. There is an extensive yard at that point and the third rail would be a disadvantage. At the same time it is not a comfortable proposition to consider the use of a 3,000 volt trolley overhead in that yard, and the question of the location of the conductor in the tunnel is also somewhat of a puzzle.

In conclusion Mr. Damon said: As the matter stands at the present time, the electrical engineering fraternity is a unit in offering to the steam railroad officials as a solution of the electrical equipment of their line, this high-tension trolley. The development of the single-phase motor is simply an incident to the use of the high tension trolley. Are you going to allow us to suspend it 22 ft. above your track, or are you going to raise the objection that there it would be dangerous to your employees in case of breakage? It may cause damage and may suddenly stop your traffic. Or are you going to insist upon putting it at the side of the track? If so, have we got to get up some new device to collect the current from this trolley?

In Europe they have developed the system called the Huber, in which the trolley is at the side of the track, taking the current by a collector which reaches over and slides on the top of the conductor; this system has certain advantages. You can have a duplicate system of wires along your line and they would not have to be very heavy wires. At Port Huron we are going to use 3,000 volts. On a long line such as that one of 180 miles, we will use perhaps 15,000 volts. This is a little hotter medicine, but it is the solution, I believe, of the problem. We are here with a solution, we are ready to run your roads, we believe we can do it economically, and it is just a question now of how you will take your medicine.

Tank Locomotives.*

One of the marked differences between the train service and locomotive equipment of American and European railroads is in the extensive use of tank engines by the latter and their limited use by the former. The great suburban traffic of the city of London, both on the purely local lines and on the main lines entering that city, is handled al-

*Abstract of paper read at the April meeting of the Western Railway Club by E. E. R. Tratman.

most entirely by tank locomotives of various designs, hauling very heavy trains. The same is true of other large cities in Europe. But in Europe, suburban service is not their only field; they are also extensively employed on the less important lines and branches, and in operating general passenger and freight trains for local runs on the main lines. These runs are from 20 to 40, or even 75, miles long. For example, the Lancashire & Yorkshire (England) uses tank engines of the 2-6-2 and 2-4-2 type for ordinary fast passenger trains on main runs of 45 and 52 miles, with trains of 200 tons and a speed of 42 miles an hour. They take water from track tanks when running in either direction. The Great Northern (England) also uses 4-4-2 tank engines to some extent on runs of from 20 to 30 miles hauling trains of 200 tons. The same statement holds true of the Great Eastern.

The advantages of tank engines are largely in their handiness, the short length of track occupied, and the facility of running in either direction. This last feature avoids the switching movements required in turning the engines, which is an important matter at very small as well as very large terminal points. In freight service, tank engines with six wheels (all coupled) or six coupled wheels and a pair of trailing wheels are extensively employed on terminal and belt lines, not only for switching, but also for road service.

The early use of tank engines in this country was largely due to Mr. M. N. Forney, who invented and patented, in 1870, a locomotive having only the driving wheels under the boiler, and with the frame extended back to carry a tank and the coal bunker; this extension was supported by a trailing truck. The most conspicuous use of the Forney type of tank engine in this country has been in elevated railroad service, it having been the standard on the New York roads at the time of their conversion to electric traction. Several American railroads are now using tank locomotives for suburban service, among them being the Long Island, Central Railroad of New Jersey, and the Chicago & Western Indiana, where the English practice of placing the tanks on each side of the boiler has been adopted, thus reducing the length of the engine.

In the discussion it was generally conceded that there was a very fitting place for tank engines, though it was contended that they are not suited to heavy service, with their small wheels and limited coal and water supply. The answer to this was that tank engines need not have small wheels, and those in main line service abroad usually have wheels of 60 in. diameter, or more. Some tank engines of the Great Western (England) mentioned in the paper, have driving wheels 80½ in. in diameter, and tank engines on this road have runs of 75 miles, 36 miles without a stop. Tank engines listed in this paper carry as much coal and water as the tenders of the old engines which they have superseded. Of course a small suburban engine, whether of the tank or tender type, cannot be used for a very heavy service. In conclusion, the author of the paper claimed that the results of the introduction of tank locomotives on a number of railroads in this country will warrant the motive power and transportation departments in giving careful consideration to the advantages of this type of engine for special kinds of service.

Cross-Compound Consolidation for the "Soo" Line.

The Minneapolis, St. Paul & Sault Ste. Marie is having built at the Schenectady works of the American Locomotive Company some heavy cross-compound consolidation locomotives, illustrations of which are shown herewith. The first heavy consolidations of this kind used by this road were built in 1900 and had narrow fireboxes. The following year some additional engines of the same design were built, with the exception that they had wide fireboxes. In the present lot the diameter of the high-pressure cylinder has been increased ½ in., and the stroke has been increased from 30 in. to 34 in., using a 63-in. driver instead of a 55-in. The principal dimensions of the 1901 and the present locomotives are given in the subjoined table for purposes of comparison. The new engines are considerably heavier and are larger in nearly every way.

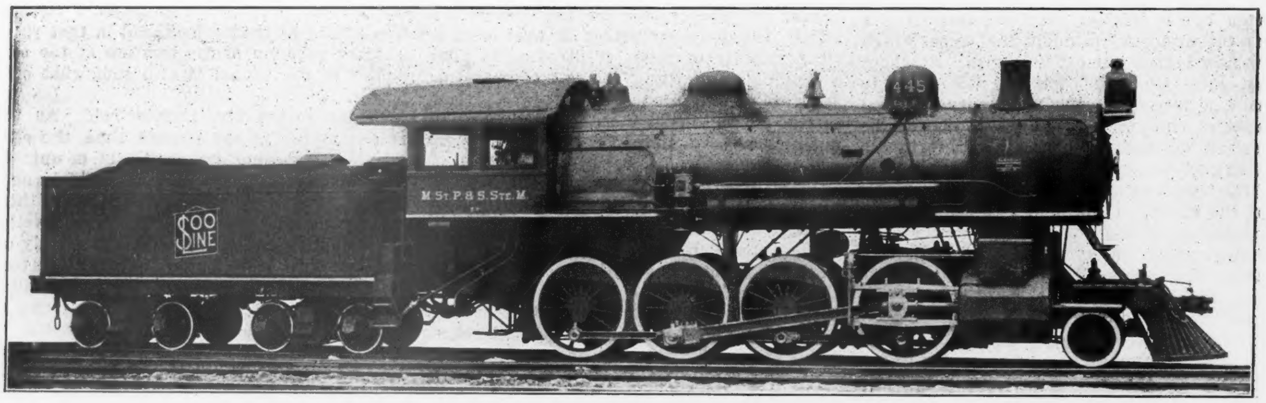
All of the consolidations used by the road are compounds and are reported to have been eminently satisfactory. It is belived, however, that the increase in driving wheel diameter will give a greater mileage between tire turnings and reduce the wear of the main boxes. The engine illustrated, No. 445, which is the only one of the lot yet built, is equipped with a Cole superheater. The trial is experimental on the part of the road, and if the results are satisfactory, the remaining engines on the order will be similarly equipped.

The older engines have straight-top boilers, while the new one has an extended wagon-top. The latter type has proven very successful on the "Soo," especially in bad-water districts. The design provides generous water spaces and contains other features which are thought to be an improvement, and it is expected that little trouble will be experienced from leaking and from broken stay-bolts where the water is bad. Two years ago some mogul locomotives with the same general design of boiler were put in service in the bad water districts and the good results have exceeded expectations. It has not only been possible to keep the boilers clean, but after two years of service no signs of deterioration are apparent and there have been no broken stay-bolts. On some of the narrow fire-box locomotives broken bolts have existed to an annoying extent.

The foregoing information was obtained from Mr. T. A. Foque, mechanical superintendent of the road. The dimensions of the 1901 and 1905 locomotives are as follows:

	1905.	1901.
Engine	No. 445.	No. 435.
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Weight on drivers	174,000 lbs.	156,600 lbs.
" " truck	27,500 "	23,400 "
" total	201,500 "	180,000 "
Wheel-base, driving	17 ft.	16 ft. 6 in.
" total eng.	25 ft. 11 in.	24 " 7 "
" eng & tdr	55 " 10½	52 " 2 "
Cylinders:		
Diam. & stroke	23 & 35 x 34 in.	22½-35x30 in.
Spread	86 in.	86 in.
Driving wheels:		
Diameter	63 "	55 "
Centers, diam.	56 "	48 "
Centers, material.	Cast steel.	Cast steel.
Journals	9½ & 9x12 in.	9½&8½x10 in.
Engine, truck whls.	33 in.	33 in.
Engine truck j'rnals	6x10 in.	6x10 in.
Frames, width	4 ft. ½ in.	4 ft. ½ in.
Boiler, type	Ext. w. t.	Strt. top.
" diam.*	67⅜ in	70½ in.
" pressure	210 lbs.	210 lbs.
Firebox, lgth & wdth	96⅛x70¼ in.	102⅛x65 in.
Tubes, No. & diam.	(224) 2-in., (40) 3½-in.	(326) 2-in.,
" thickness	No. 11, No. 8.	No. 11.
" length	15 ft. 9 in.	14 ft. 6 in.
Htg. surf., tubes	2,407.53 sq. ft.	2,360.83 sq. ft.
" " firebox	157.97 "	157.95 "
" " total	2,565.5 "	2,618.78 "
Grate area	46.8 "	46.09 "
Tractive power	37,300 lbs.	37,000 lbs.
Factor of adhesion	4.51	4.32
Center of boiler from rail	115 in.	110 in.
Superheat htg surf.	261.4 sq. ft.	....
Tender frame	10-in. stl. chnl.	10-in. stl. chnl.
" wheel, diam.	33 in.	33 in.
" truck, type	2 4-whl. C. B.	2 4-whl. C. B.
" journals	5½x10 in.	5½x10 in.
Tank type	U-shape.	U-shape.
" water cap.	6,000 gals.	6,000 gals.
" fuel	10 tons.	10 tons.

*O. D. first ring.



Two-Cylinder, Compound Consolidation (2-8-0) Type Locomotive, M., St. P. & S. Ste. M.

The Central London is now running 31 trains an hour each way over its entire line during the morning and evening rush hours. The Great Northern & City has lengthened its trains from three to five coaches and is running 24 trains an hour. Through the hours of lighter traffic, a considerable saving has been made in operating expenses by reducing the trains to two or three cars. The new tube railroads which are now being built are making arrangements with existing underground lines for connections.

GENERAL NEWS SECTION

NOTES.

It is announced that the Central of New Jersey has finally abandoned all brass baggage checks and will use pasteboard cards for all baggage.

Chests containing supplies for "first aid to the injured" are now carried on all trains on the Southern Pacific lines in Texas, including passenger trains, freight trains (cabooses) and work trains.

The Governor of New York has approved the law recently passed requiring railroads to have locomotive boilers inspected regularly, and authorizing the appointment of a state boiler inspector, at a salary of $3,000.

The Governor of Indiana has announced that under the railroad law of that state, recently enacted, all officers of the state are forbidden to accept a pass from a railroad; and he intends to see that the law is obeyed.

Complying with the new railroad law of the state the Great Northern and the Northern Pacific have reduced passenger rates in Washington to 3 cents a mile; and it is said that all outstanding annual passes have been recalled.

A trainload of boats (motors and Venetian gondolas) for the Lewis and Clark Exposition was taken over the Rock Island line from Joliet, Ill., to St. Paul (534 miles) in 18 hours 30 minutes. The train consisted of 17 cars, of which 14 were 41-ft. platform cars, on which were 40 boats.

The Canadian Pacific has just completed its last new grain elevator at Fort William, Ontario. It will hold six million bushels. From this elevator ships can be loaded at the rate of 100,000 bushels an hour. At Fort William and Port Arthur the combined grain storage capacity is now 14,500,000 bushels, which includes the five million bushel elevator of the Canadian Northern.

On the Philadelphia division of the Pennsylvania Railroad an order has been issued directing that all freight trains be made up so that at least 60 per cent. of the cars shall be air-braked; and, according to the Harrisburg *Telegraph*, all yardmasters on the Pennsylvania Railroad division have been instructed to "use every precaution" to have all trains equipped with 100 per cent. of air, when possible.

The Pennsylvania now runs a second fast mail train from New York to St. Louis daily, leaving New York at 8 a.m. East of Pittsburg this train will carry nothing but mail, but west of that city it will also carry passengers. The time through will be 25 hours, which is 30 minutes slower than that of train No. 11, the fast mail which has been running for the past year or two, leaving New York about 3 a.m.

Under the decision of the Canadian Government, recently reported, to deport alien workmen, two officers of the Pere Marquette at St. Thomas, Trainmaster Cain and Chief Despatcher Gilhula, were arrested on the evening of June 2. A press despatch a few days later said that a writ of habeas corpus had been issued in favor of the men, but no announcement of the result of this action has yet been made.

The dining cars to be run between New York and Philadelphia over the Philadelphia & Reading and the Central of New Jersey, as recently announced, will be put in service on June 12. There will be two each way in the morning (7 o'clock and 8 o'clock); two each way at noon (12 o'clock and 1 o'clock); and two each way at night (5 o'clock and 6 o'clock). On the evening trains meals will be one dollar each; on the others they will be served by the card.

The new railroad law of Minnesota, requiring the railroads to make application to the Railroad Commission, giving reasons, before changing freight rates, has produced a marked shrinkage in the number of special tariffs filed with the commission. Before this law took effect the only tariffs which had to have the commission's consent were those on coal, lumber, grain and live stock; and new tariffs on other commodities came in at the rate of ten a day. Many of these were kept in force only a few days.

According to a press despatch from Connellsville, Pa., a train robber was caught by the policemen of the Baltimore & Ohio Railroad in the mountains near that town on the night of May 27 by means of a decoy train. The officers of the road had been informed of an intended attack on train No. 10 and sent out as the first section of that train an engine with one car, carrying armed men. The train was stopped by red lights, the guards jumped off and began shooting and captured one of a gang of robbers. It is said that the prisoner is a former brakeman of the road.

Canadian vessels have been taking corn from Chicago to Montreal at the very low rate of 3¾ cents a bushel, contracts at this rate being reported as taken by the Canada Atlantic and the Great Lakes & St. Lawrence Company. It is said that these Canadian lines do not thus reduce the rates for shippers from Canadian ports, all being bound by an agreement to maintain rates on that traffic, and the competition of American vessels being kept out by the Canadian navigation laws. The movement of grain from Canadian ports is now slack, and so the idle vessels are sent to Chicago to get a share of the traffic going from there.

The Public Service Corporation, operating extensive electric roads in Newark and other cities in New Jersey, has been investigating the frauds perpetrated on the company by means of transfer tickets and other tricks, and finds evidence that great numbers of passengers have thus secured free rides. One officer of the company says that the losses have amounted to several hundred thousand dollars. He says that the investigation has shown that similar frauds are being perpetrated on the steam railroads in that region, and that there has been found in New York City a school for the instruction of conductors in the best methods of carrying out schemes for robbing their employers.

The International Waterways Commission, made up of three representatives of the United States and three of the Dominion of Canada, held its first meeting at Washington, May 25 and 26. General Oswald H. Ernst, Corps of Engineers, U. S. A., was elected Chairman for the meetings held in the United States. At meetings held in Canada, a Canadian member will act as Chairman. Future meetings will be held alternately at Buffalo and Toronto. The commission was appointed to investigate the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, whose outlet is by the St. Lawrence river, and also to decide upon the advisability of building a dam at the outlet of Lake Erie.

Discrimination in Charges for Reconsignment.

The Interstate Commerce Commission in an opinion by Commissioner Prouty has announced its decision in the case of the St. Louis Hay & Grain Company against the Mobile & Ohio, Illinois Central, Louisville & Nashville and Southern Railway Companies. The reconsignment of hay from East St. Louis is held to be a special privilege, which the carrier may concede, but which the shipper cannot demand as a matter of lawful right. Nevertheless the carriers may not unjustly discriminate between markets or individuals in granting such privileges. In allowing the privilege of reconsigning hay at East St. Louis to southern destinations, the carriers are entitled to charge for the privilege what it actually costs them; the fair average cost when hay is handled through warehouses above the cost of handling a through shipment is $2.00 to $2.50 per car, or approximately one cent per 100 lbs. Shipments routed through East St. Louis are carried from that point to southern destinations at a proportional rate which is 2 cents above the rate from Ohio river crossings to the same destinations. Hay reconsigned to such points from warehouses in East St. Louis is charged 4 cents above the Ohio river rate. It is stated that hay is reconsigned from warehouses at Ohio river points, and at Nashville and Memphis, to southern points without additional charge.

The Commission holds that the carriers' rates on reconsignments of hay from warehouses in East St. Louis to points south of the Ohio river, amounting to 2 cents more than their proportional rate from East St. Louis on through shipments, are unjust and unreasonable, and that complainant is entitled to reparation.

New York Subways.

The New York City Rapid Transit Commission has approved plans for a crosstown subway and tunnel from Eleventh avenue, in Manhattan, under 34th street in Manhattan, and under the East river to Jackson avenue and Fifth street, in Long Island City. This is to be a four-track road across Manhattan and a two-track road under the East river and in the borough of Queens.

Also for a four-track cross-town line on Fourteenth street from the Hudson river to a point betwen avenues B and C, where connection can be made with the bridge loop which is to connect the Williamsburgh, Manhattan and Brooklyn bridges. This loop is to tunnel the East river to Williamsburgh opposite Fourteenth street. The Fourteenth street line will also have two double-track spurs; the first through Ninth avenue, Greenwich, Liberty and William streets to the proposed Old Slip tunnel under the East river to Brooklyn; the second down University place, Wooster, Canal and Center streets to connect at the Brooklyn bridge with the bridge loop.

Also the following: First avenue subway; West street and Ninth avenue subway; Jerome avenue subway and elevated extensions

in the Bronx; Girard avenue subway in the Bronx; extension along West Farms and White Plains road, and along the Southern boulevard and Westchester avenue in the Bronx.

In Brooklyn, the routes approved by the Commission are along Fourth avenue to Fort Hamilton; along Eastern Parkway to Brownsville; from Greenpoint to the Blackwell's Island bridge, and a subway to Jamaica, with various spurs. The main tunnels are to come together at the Borough Hall Park and can be connected with any of the proposed extensions under the East river.

It is announced that bids for building the new subways will be asked about the first of next year.

American Locomotive Company to Make Automobiles.

An announcement which is probably one of the most interesting made for some time past in the automobile industry is that the American Locomotive Company has consummated arrangements for the manufacture on this side of the Berliet automobile. Although one or two foreign designed cars are built in part here, this will be the first instance of an American concern making a foreign car with American material and by American labor, complete in every detail. The company will immediately begin the construction of a specially equipped plant adjacent to its Rhode Island Works, Providence, R. I., for the manufacture of the Berliet machines, and the cars will be in the market early next season. The plant will be under the supervision of Mr. Haughton, who has recently been appointed superintendent of the Rhode Island works. The initial output will be about 200 cars, and the first machines are to be of 40 h.p. and 25 h.p., and are to be built exclusively for private purposes. Later, automobile trucks for heavy transportation use will be made.

Erie Shop Improvements.

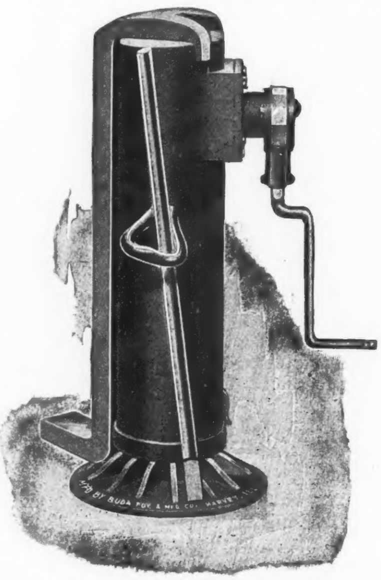
The Erie Railroad plans to increase its locomotive repair shops this year by the installation of about $470,000 worth of high-speed machine tools, and by building five new 95-ft. engine houses, as well as a number of other shop buildings. At various points 15-ton capacity locomotive coaling cranes are to be built. Six of the smaller shops are to be made capable of repairing 100 locomotives a year. The amount to be spent for new tools at the larger shops is as follows: At Dunmore, Pa., $30,085; Hornellsville, N. Y., $145,225; Buffalo, $30,000; Meadville, Pa., $79,679; Cleveland, $40,000; Galion, Ohio, $34,000; Huntington, Ind., $46,000.

British Railroad Earnings in 1904.

The preliminary statement issued by the Board of Trade for the last calendar year shows the earnings of the railroads of the United Kingdom (22,600 miles) to be £111,828,000 as compared with £110,946,091 in the preceding year. Passenger receipts (48.4 millions) increased £411,000 over the preceding year, and freight receipts (55.4 millions) increased £285,000. Ton mileage is not reported, but the increase of 6,107,000 in tons carried (from 443.7 to 449.8 millions) is at about the same rate as the increase in receipts, while the mileage of freight trains decreased from 159.7 millions to 155.2 millions, indicating probably an increase in the average train load. The total train mileage was 396,964,000 as compared with 394,015,320 in the preceding year. The number of passengers carried, exclusive of season ticket holders, was 1,198.6 millions, a slight increase from the preceding year. Both first-class and second-class show small decreases, the increase being wholly in third-class.

Buda Ball-Bearing Jack.

The illustration shows Style 110 ball-bearing locomotive jack, recently added by the Buda Foundry & Mfg. Co., Chicago, to its list of railroad appliances. The internal working parts are protected from all dirt and from the weather, an important feature in this class of jack, if it is to be in working order whenever needed. It is 24 in. high and has an 11-in. rise. The diameter of the

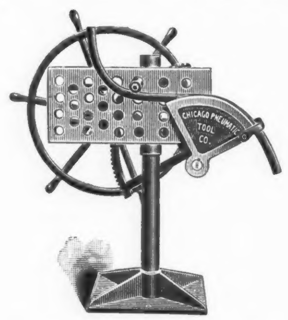


The Buda Ball-Bearing Jack.

base is 13 in., its capacity is 25 tons, and its weight 149 lbs. A hook for low-set loads is provided, making it applicable to locomotive work. The component parts are of the best material and the workmanship equally good.

The "Chicago" Pipe Bending Machine.

The illustration shows the "Chicago" pipe bending machine. Although simple in design and construction, it is claimed that a large variety of work may be done with it. One unskilled laborer is required to operate it, the machine enabling him to turn out a variety of pipe-bending work in much less time than skilled mechanics may require on other



The Chicago Pipe Bending Machine.

types of machines. It is light in weight and therefore easily portable. It can be secured quickly to any convenient support, or a stand is furnished with it if desired. One man can bend with it piping of steel, iron, brass, copper or other material up to 2 in. in diameter. By the use of special dies, readily attachable, light angles, flats, or tee bars may be bent as easily as pipe. Pipes coated with the Sabin process, galvanized, tinned, etc., can be bent without breaking the coating. One man can bend a 2-in. pipe to an S shape in three minutes without assistance or use of any other device. The cost of repairs has been shown from actual service to be small. It is made by the Chicago Pneumatic Tool Company.

International Delegates at Coney Island.

On May 31, the *Railroad Gazette* entertained at Coney Island a party of about 50 delegates to the International Railway Congress who had just returned from the long tour, and were about to sail for home. The foreigners had seen a great deal of the busy side of American life, but this was their first trip to one of the nation's playgrounds. They were immensely diverted by the shows at Dreamland and Luna Park, which were thrown open to them by courtesy of the managements. The party went down and returned on a special train supplied by E. W. Winter, President of the Brooklyn Rapid Transit.

Philippine Railroads.

John F. Stevens, formerly Second Vice-President of the Chicago, Rock Island & Pacific, in charge of traffic, has been appointed railroad expert of the Philippine Railroad Commission.

Panama Canal.

David W. Ross, General Superintendent of Transportation of the Illinois Central, has been appointed Purchasing Director for the Panama Canal, with headquarters in Washington.

Disastrous Wreck on the Metropolitan Railway.

At Aylesbury, England, on December 23, a Great Central Railway passenger train consisting of an engine, tender and 10 cars ran off the track at a junction because of too high speed through a curve of 540 ft. radius; and the inspector, Colonel Yorke, describes the accident as one of the worst cases of derailment that has occurred in the United Kingdom. Three or four coaches were telescoped together in such a way that they appeared as one coach. There were only half a dozen persons on the train and all of these were employees, though some of them were riding as passengers. Three of the six were killed. The reason that there were no other passengers was that the train starts at 2.45 a.m. It is used chiefly to carry newspapers. It was wrecked at about 3.38 a.m.

The derailment was due to the fact that the engineman was not well acquainted with the road and disregarded a rule requiring him to approach the junction of the Metropolitan with the Great Western at 15 miles an hour. The junction is at the foot of a long grade and the train approached it (from the Metropolitan) traveling at about a mile a minute. There was a dense fog. The fogmen were at their posts; but the signals were all off, so that no torpedoes were in position. The fogmen exhibited their green hand lights, but Engineman Barnshaw either did not see these lights or else from his imperfect acquaintance with the line had "lost his bearings," and mistook the location.

The foregoing covers the main features of the accident, but Colonel Yorke's conclusion fills four pages, nevertheless. This conclusion is largely taken up with the engineman's lack of acquaintance with the line. Barnshaw was fatally injured and was unable to give any explanation of his action in approaching so dangerous a curve at a recklessly high speed.

Barnshaw was a steady and reliable driver, a total abstainer and had a good record; but the trouble was that he had not been over the road many times. Enginemen certify to their knowledge of a given line by signing a "road paper." Barnshaw's road paper was made in October, 1901. Not until March, 1904, did he have occasion to become acquainted with the line to London; then his

road paper was revised, and his initials were written against the London section to show that he knew it; but there is no evidence as to how much he had worked on the London section, and, in fact, he had not been in London at all after this last signature until the night before the fatal derailment. He was a relief runner, and on being called to take an extra passenger train to London he asked for a pilot man. By mistake a pilot guard was sent instead; but Barnshaw did not insist, and although he had not been to London for twelve months, he said that he could manage without a pilot man. He was offered the services of a freight engineman, but he went on without him. He arrived in London, all right, at 5 a.m., booked off duty at 8 a.m. and went to bed at 10.15. On being notified that he was to take a train back the next morning at 2.45 he asked for a more experienced fireman, so that he should not have his attention drawn away from the signals. Colonel Yorke thinks that what he really wanted was a pilot man, and holds that Barnshaw was not justified in running over this line without a pilot man and that those responsible were not justified in allowing him to run either to or from London as he did, especially at night during a thick fog. There is a slow board at Aylesbury Junction, but it is so near to the point of danger as to be of no use at night in a fog. The printed slow-notice in the book "may easily have escaped Barnshaw's notice."

Colonel Yorke considers the question whether both Barnshaw and his fireman were asleep, but in view of the runner's good reputation and his known anxiety beforehand concerning his duty, the inspector does not think he would have allowed himself to fall asleep.

The most obvious lesson from the disaster, in Colonel Yorke's opinion, is that so sharp a curve should not be allowed to exist at a junction traversed by high-speed trains. The slow board being useless, Colonel Yorke thinks that a more rational plan would be to have the distant signal remain constantly in the danger position. The objection that such signals are ignored by runners, cannot be accorded much weight, for it would apply equally to all slow boards. Finally, Colonel Yorke points out the unsatisfactory arrangements for the signing of road papers. It appears that the signature is taken without a witness and without any questions or examination to see if the runner actually knows the road in accordance with his certificate.

Manufacturing and Business.

Wm. F. Watson, formerly District Sales Manager of the American Steel Foundries, with offices in Pittsburg, has resigned his position.

The American Steel Foundries, New York, has an order from the Atlantic Coast Line for 3,000 cast-steel body bolsters for the 1,500 box cars reported in our Car Building column.

The American Tool Works Co., Cincinnati, Ohio, has appointed Geo. M. Chandler, of Indianapolis, Indiana, selling agent for its line of lathes, planers, shapers, upright drills and radial drills.

A contract has been let by the Chicago & Eastern Illinois to William B. Scaife & Sons, of Chicago, for building water-softening and purifying systems at Sollitt, Ill., and at Dickason, Ind., each to have a capacity of 16,000 gallons an hour.

John T. Bramhall, for the past three years in charge of advertising for the Michigan Central, with headquarters in Chicago, has been appointed Transportation and Advertising Manager of the Battle Creek Sanitarium, Battle Creek, Mich.

The Vulcan Iron Works Co., Toledo, Ohio, has shipped a "Little Giant" steam shovel to the Northern Mines Co., Ltd., Atlin, B. C., for use in placer work. The sale was made through Rochussen & Collis, Victoria, B. C.

Contracts have recently been placed by the Japanese Government in this country amounting to about $5,000,000 for electrical equipment, machines and tools. The machinery will be placed in government shipbuilding yards and arsenals. All the orders are for early delivery.

Mr. Paul Morton, Secretary of the Navy, will retire from the cabinet on July 1 and will become associated with Thomas F. Ryan in the project for building the proposed comprehensive system of underground and rapid transit lines in New York City to be operated in connection with the existing (surface) lines of the Metropolitan Street Railway.

The Westinghouse Air Brake Co. has received orders for equipments of Westinghouse friction draft gear for a total of 150,000 cars from the Chicago & Alton, Baltimore & Ohio; Bessemer & Lake Erie; Chicago, Burlington & Quincy; Lake Shore & Michigan Southern; Mexican Central; Lehigh Valley; Pennsylvania; Philadelphia & Reading; West Side Belt; Duluth, Missabe & Northern; Duluth & Iron Range; Northern Pacific; Butte, Anaconda & Pacific, and Missouri Pacific.

United States Consul Brush, of Milan, Italy, reports that there is interest in business circles there in the question of purchases of rolling stock by the government, in case it shall be decided to take the railroads out of the hands of the operating companies and operate them directly. The amount of the proposed expenditure is spoken of as $8,000,000. The material is to be bought in Italy, but there is a proviso in the law that bids may be invited from foreign countries whenever unacceptable prices or conditions are imposed by Italian bidders. The Minister of Public Works is the officer who will probably have charge of the buying.

An important event in the machinery trade was the incorporation, on May 31st, of Manning, Maxwell & Moore, Incorporated, composed of the well-known house of Manning, Maxwell & Moore, and its allied manufacturing companies, The Shaw Electric Crane Co., The Ashcroft Manufacturing Co., The Consolidated Safety Valve Co., The Hayden & Derby Manufacturing Co., The Hancock Inspirator Co., and the United Injector Co. The corporation was formed under the laws of the State of New Jersey, and is established on a basis which is unique among commercial enterprises of its kind, having a paid-up capital of five million dollars. There is but one kind of stock, known as common, non-assessable. The officers of the new concern are: Charles A. Moore, President; John N. Derby, Vice-President; Martin Luscomb, Vice-President; Stephen B. Aller, Vice-President; Colby M. Chester, Jr., Treasurer; J. H. Blue, Assistant Treasurer; Charles Arthur Moore, Jr., Secretary, and Merle S. Clayton, Assistant Secretary. There is to be a board of 15 directors, among which are some very prominent New York business men. The present directors are: Charles A. Moore, John N. Derby, Charles A. Moore, Jr., Colby M. Chester, Jr., J. Rogers Maxwell, Edmund C. Converse, Martin Luscomb, Stephen B. Aller, Alfred Brotherhood, Robert A. Bole, John G. Emery, Jr., James B. Brady, P. M. Brotherhood and A. J. Babcock. Business will be carried on at the home office of Manning, Maxwell & Moore, New York, and through its branch offices in Boston, Philadelphia, Chicago, Cleveland, Pittsburg and St. Louis.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 24.)

American Society for Testing Materials.

The eighth annual meeting of this society will be held at Atlantic City, N. J., June 29 to July 1. The headquarters will be at the Hotel Chalfonte. Special rates to members and their guests have been secured at $3.50 a day, or $5 with bath. Reduced railroad fares have been arranged for. The nominations to be voted upon at this meeting include the names of W. A. Bostwick and John McLeod for members of the executive committee.

PERSONAL.

—Mr. Eldridge G. Howe, formerly Assistant Chief Engineer of the Cincinnati, Hamilton & Dayton, died recently.

—Mr. George Gibbs resigned as Vice-President of Westinghouse, Church, Kerr & Co., and also as Consulting Engineer to the Interborough Rapid Transit Company, taking

effect June 1, to become Chief Engineer of electric traction of the terminal operation of the Pennsylvania Railroad in New York City, and also Chief Engineer of electric traction of the Long Island Railroad. In these two positions he will have charge of, for the Pennsylvania Railroad, all electrical and mechanical engineering, and design and execution of work in connection with the tunnels, yards, terminals, power houses, etc., in New York. He will also, of course, be brought into any other electric traction schemes that the road may have. For the Long Island Railroad his task will be the designing and installation of all electric traction work which the company is now doing or has in contemplation. This latter constitutes the largest electric traction project on any steam railroad in the world. Mr. Gibbs will also be Consulting Engineer of the Metropolitan interests in their other railway facilities. He designed for the Interborough the first steel passenger cars in the world, and also applied the over-lapping block signal system to congested train movement for the first time in this country. As member of the Pennsylvania board of engineers to carry out the work of the Pennsylvania terminal, he had special charge of the electrical power plants, electric locomotives, power distributing system, and mechanical engineering features of the terminal yards and buildings. On the New York Central he was Consulting En-

gineer of electric traction work; the equipment of heavy electric locomotives, power plants and distributing system. He is also confidential adviser in Engineering, Carnegie Institute, Washington, D. C., and a member of the American Society of Civil Engineers, the Institution of Civil Engineers, England; the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Railway Master Mechanics' Association, and the Master Car Builders' Association.

Graduating in 1882, with degree of Mechanical Engineer, from the Stevens Institute of Technology, Hoboken, N. J., Mr. Gibbs was engaged from 1882 to 1884 as Chemist of the Orford Copper Company. From 1884 to 1888 he was Engineer of Tests and Chemist of the Chicago, Milwaukee & St. Paul. From 1888 to 1897, Mechanical Engineer of same road. In this position he had charge of car and locomotive design for the road, also interlocking and track signals. From 1897 to 1902, Consulting Engineer of the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company; also Chief Engineer of the British Westinghouse Electric & Manufacturing Company, Ltd., and of the Continental Westinghouse Companies. From 1901 to date, First Vice-President of Westinghouse, Church, Kerr & Company, Engineers, New York; Consulting Engineer, Interborough Rapid Transit Company, New York; Member of Board of Engineers, Pennsylvania Railroad, New York tunnel line and terminals; member of Electric Traction Commission, New York Central & Hudson River Railroad Company, New York Terminal and electric traction plans; Electrical Engineer, Long Island Railroad Company, electric traction. He had charge of the following work for the Interborough Rapid Transit Company; design of rolling stock, track work, interlocking and signals, shop yards and repair plants, and generally in consultation upon proposed subway work in New York City.

The importance which attaches to the position of Chief Engineer of electrification of the suburban services in the vicinity of a great city is as yet scarcely realized, even by railroad men. Mr. Gibbs has precedents for part of his task, but he will have to accomplish much of it at first hand. His extremely brilliant record in the comparatively brief period of his professional career shows his capability to dispose of each problem as it comes along. In giving up his Vice-Presidency of Westinghouse, Church, Kerr & Co. to take up what is well-nigh pioneer work, Mr. Gibbs is performing a service to every railroad in the world that is confronted with the problem of handling short haul traffic expeditiously and profitably in congested territory.

—Mr. Royal M. Bassett, for many years President of the Utah Northern, and a Director of the Naugatuck Railroad, died on May 25 at his home in Derby, Conn.

—Mr. James Albert Murray, General Coal and Coke Agent of the Baltimore & Ohio, died recently after a long illness. He had been in the employ of the Baltimore & Ohio since he was twelve years old, having begun as a messenger.

—Mr. J. O. Pattee, until recently Superintendent of the locomotive and car departments of the Missouri Pacific, died on May 25 at his home in St. Paul, Minn. Mr. Pattee was born at Alexandria, N. H., in 1835, and in 1857 entered the service of the Chicago, Milwaukee & St. Paul as a locomotive fireman. He served successively as engineer, machinist, foreman and Master Mechanic of this road. In 1888 he became Master Mechanic of the Great Northern and later Superintendent of Motive Power. On Jan. 1, 1900, he went to the Missouri Pacific as Superintendent of the locomotive and car departments and remained with that company until May 1, 1902.

—Edward A. Niel, who has been appointed Traffic Manager of the Buffalo & Susquehanna, was born in Selma, Ala., June 3, 1865, and began railroad work as office boy when 13 years old in the office of the Superintendent of the Selma, Rome & Dalton. He rose to be Superintendent of the East Tennessee, Virginia & Georgia. From 1895 to

1899, he was General Freight and Passenger Agent of the Mobile & Birmingham, and in the latter year was made Assistant General Freight Agent of the Southern. A year later he was made General Freight Agent. At the time of his recent appointment he was Traffic Manager of the Atlantic & North Carolina.

—Mr. Newton Heston, for many years Purchasing Agent of the Seaboard Air Line, died May 31 at his home in Orange, N. J.

—Mr. Clarence Morgan, a graduate of Harvard University, and until recently Secretary and Treasurer of the Rutland Railroad, has been appointed the first professor of the new railroad and transportation course at McGill University, Montreal.

—The accompanying portrait is that of Mr. D. W. Dinan, Superintendent of the

Pennsylvania division of the New York Central & Hudson River. The photograph arrived too late for publication with the sketch of his life in our issue of last week.

—Mr. George Henry Clark, many years ago Superintendent of the Albany Northern, now a part of the Delaware & Hudson, and Resident Engineer of the Erie Canal, died recently at his home in Brooklyn, at the age of 85. He was a well-known civil engineer.

—Mr. Thomas Fitzgerald, General Manager of the Baltimore & Ohio, was the recipient at Fairmont, W. Va., May 27, of a quite unusual testimonial—a dinner given by his friends among the officers and employees (which apparently includes every person on the road) and attended by the Governors of Maryland and West Virginia and the President and all the Vice-Presidents of the railroad company. As is well known, Mr. Fitzgerald has been on the Baltimore & Ohio all his life, and he is personally known by a large percentage of the employees. He began as waterboy with a track gang. According to a statement made by the Governor of Maryland in his address, Mr. Fitzgerald was born on the same day that the first train was run through over the road to Wheeling (Jan. 1, 1853). When Mr. Fitzgerald began his service on the road, in 1866, the earnings were less than eight millions a year; now they are over 70 millions. The number of persons employed now is over 57,000.

ELECTIONS AND APPOINTMENTS.

Arkansas Midland.—J. B. Johnson, Superintendent, has resigned.

Atchison, Topeka & Santa Fe.—F. J. Easley has been appointed Superintendent of the Middle division, with headquarters at Newton, Kan., succeeding F. C. Fox, promoted. Charles Russell has been appointed Superintendent of the New Mexico division, with headquarters at Las Vegas, succeeding Mr. Easley. E. R. Raymond, Assistant Superintendent of the Southern Kansas division, has been appointed Superintendent of the Illinois division, with headquarters at Chillicothe, Ill., succeeding Mr. Russell.

Atlantic City.—See Philadelphia & Reading.

Baltimore & Ohio.—J. B. Dickson, Engineer Maintenance of Way, has been appointed Chief Engineer Maintenance of Way, with headquarters at Baltimore. The maintenance of way department has been divided as follows: H. E. Dale, Division Engineer at Baltimore, has been appointed Engineer Maintenance of Way of the main line system, with headquarters at Baltimore; H. H. Temple, who has been Division Engineer at Pittsburg, has been appointed Engineer Maintenance of Way of the Pittsburg system, with headquarters at Pittsburg, and J. A. Spielmann, formerly Superintendent of the Chicago division, has been appointed Engineer Maintenance of Way of the Wheeling system, with headquarters at Wheeling, W. Va. Mr. Hale is succeeded as Division Engineer, with headquarters at Baltimore, by V. K. Hendricks, who has been Assistant to the Engineer Maintenance of Way; Mr. Temple, as Division Engineer, with headquarters at Pittsburg, by L. P. Rossiter, who has been Assistant Engineer of the Shenandoah division, and Mr. Rossiter is succeeded, as Assistant Division Engineer, with headquarters at Winchester, Va., by F. J. Bachelder. The division engineers will report to the Assistant Engineer, who in turn will report to the Chief Engineer Maintenance of Way.

California Northwestern.—J. L. Frazier, General Manager, has resigned on account of ill health.

Central of Georgia.—J. H. Hall has been appointed Superintendent of the Macon division, with headquarters at Macon, succeeding C. B. Wilburn, resigned. H. D. Pollard, Roadmaster, has been appointed Superintendent of the Southwestern division, with headquarters at Macon, succeeding J. H. Hall, transferred.

Cincinnati, Hamilton & Dayton.—R. H. Bowron, Superintendent of the North and

South divisions, has been appointed General Manager of the Cincinnati, Hamilton & Dayton and Chicago, Cincinnati & Louisville, with headquarters in Cincinnati, succeeding J. A. Edson, who has gone to the Kansas City Southern.

George M. Cummings has resigned as Chairman of the Board of Directors.

Denver & Rio Grande.—See Kansas City Southern.

Detroit, Toledo & Ironton.—George M. Cumming, President of the United States Mortgage & Trust Co., has been elected President, with headquarters at Detroit, succeeding Samuel Hunt, deceased.

Dublin & Southwestern.—J. C. Pierce has been appointed Treasurer, with headquarters at Dublin, Ga.

Duluth, South Shore & Atlantic.—Martin Adson, General Agent at Duluth, has been appointed General Passenger Agent, succeeding George W. Hibbard, resigned.

James Maney, Rate Clerk, has been appointed Assistant General Passenger Agent, with headquarters at Duluth.

El Paso & Southwestern.—A. N. Brown has been appointed General Freight Agent, and V. R. Stiles, General Passenger Agent of the El Paso & Southwestern and the El Paso-Northeastern System recently amalgamated. Mr. Brown has been General Freight and Passenger Agent of the El Paso & Southwestern and Mr. Stiles, of the El Paso-Northeastern System.

Erie.—The jurisdiction of J. C. Tucker, Superintendent of the Allegheny division, with headquarters at Salamanca, N. Y., has been extended over the Bradford division. E. T. Reisler has been appointed Assistant Superintendent of both divisions, with headquarters at Bradford, Pa.

Frankfort & Cincinnati.—Samuel E. Hutton, General Freight and Passenger Agent, has resigned. He is succeeded by C. W. Hay, of the auditing department.

Gainesville Midland.—E. L. Douglass, Secretary and Treasurer, has been appointed General Manager, with headquarters at Gainesville, Ga., succeeding Samuel C. Dunlap, resigned.

Georgia Southern & Florida.—S. F. Parrott, Chairman of the Southeastern Freight Association, has been appointed Vice-President and General Manager.

Great Northern.—The title of Henry M. Adams, announced in our issue of last week as Assistant General Freight Agent, is instead Assistant Traffic Manager.

Illinois Central.—O. S. Keith, Chief Clerk to the General Superintendent of Transportation, has been appointed General Superintendent of Transportation, with headquarters at Chicago, succeeding D. W. Ross, resigned.

Kansas City Southern.—William Coughlin, General Superintendent of the Denver & Rio Grande, has been appointed General Manager, with headquarters at Kansas City.

F. Mertsheimer, Superintendent of Motive Power of the Cincinnati, Hamilton & Dayton, has been appointed Superintendent of Motive Power, succeeding W. E. Symons, Superintendent of Machinery. L. F. Jordan, Storekeeper of the Denver & Rio Grande, has been appointed Purchasing Agent, succeeding A. R. Dillon.

Lehigh Valley.—F. R. Cooper, instead of F. W. Cooper, as previously reported, has been appointed Master Mechanic, with headquarters at Buffalo. Mr. Cooper came to the Lehigh Valley from the Macon, Dublin & Savannah.

Mississippi Central.—P. W. Nunan has been appointed Car Accountant and Trainmaster, with headquarters at Hattiesburg, Miss., succeeding W. A. Vaughan, resigned.

Missouri Pacific.—W. C. Swartout has been appointed Division Engineer of the Joplin division, with headquarters at Nevada, Mo.

T. E. Byrnes has been appointed Inspector of Transportation, with headquarters at St. Louis. He will investigate the conditions surrounding train schedules, switching service and the arrangements for handling freight at local stations, junction points and terminals; and will, in conjunction with representatives of the Traffic Department make recommendations for improvements in the service. He will also report upon the efficiency of the transportation service.

R. K. Smith, Superintendent of the Missouri division, with headquarters at De Soto, Mo., has resigned.

Mobile, Jackson & Kansas City.—W. L. O'Dwyer has been appointed General Freight and Passenger Agent, succeeding L. D. Sullivan, deceased.

New York, New Haven & Hartford.—Percy R. Todd, First Vice-President, who has been in charge of both the operating and traffic departments, will in future devote his time entirely to the traffic department. The operating department is to be under the direct supervision of the President.

New York State Railroad Commission.—George W. Aldridge, who has been Secretary, has been appointed a member of the Railroad Commission. This appointment was made under the law increasing the number of railroad commissioners from three to five. The Governor has announced that the fifth commissioner will be named in two or three weeks.

Northern Pacific.—Charles M. Levey has been appointed Third Vice-President, with headquarters at Tacoma, Wash., in charge of the affairs of the company in Oregon, Washington and Idaho.

Oregon Railroad & Navigation.—J. P. O'Brien, General Superintendent, has been appointed General Manager of the Oregon Railroad & Navigation Co. and the Southern Pacific lines in Oregon, Washington and Idaho, succeeding B. A. Worthington, resigned. M. J. Buckley, Superintendent at Portland, has been appointed General Superintendent, succeeding Mr. O'Brien.

Oregon Short Line.—E. C. Manson, Superintendent of the Idaho division, has been appointed Superintendent of the Salt Lake division, including the Lucin cut-off (S. P.) west to Sparks, with headquarters at Ogden, Utah, succeeding W. R. Scott, resigned to go to the Southern Pacific. G. H. Olmstead, Superintendent of the Montana division, succeeds Mr. Manson as Superintendent of the Idaho division, with headquarters at Pocatello, Idaho. T. J. Duddleson, Trainmaster, has been appointed Acting Superintendent of the Montana division, with headquarters at Pocatello, Idaho, succeeding Mr. Olmstead. H. V. Hilliker, Assistant Superintendent, has been appointed Superintendent of the Utah division and the Union Pacific lines west of Green River, with headquarters at Salt Lake City, succeeding H. V. Platt, resigned to go to the Southern Pacific. H. J. Roth succeeds Mr. Hilliker as Assistant Superintendent.

Panama Railroad.—W. J. Thomas, formerly Chief Air-Brake Inspector of the Hocking Valley, has been appointed Master Mechanic, with headquarters at Colon.

Pan-American.—W. G. Raef, Assistant General Manager, has resigned and is succeeded by J. B. Cox, who has been Chief Claim Clerk on the Mexican Central. See San Pedro, Los Angeles & Salt Lake.

Pennsylvania.—Rufus Hill, Master Mechanic at Camden, N. J., has resigned. He is succeeded by W. B. Page, transferred from Lambertville, N. J.

Philadelphia & Reading.—C. H. Ewing, Division Engineer of the Reading and Lebanon divisions, has been appointed Engineer of Maintenance of Way of the Philadelphia & Reading and the Atlantic City Railroad, with headquarters at Reading, Pa. This is a new office.

Pittsburg & Lake Erie.—W. F. Cunningham has been appointed Freight Claim Agent. The duties of this office have hitherto been discharged by the General Freight Agent.

Queen & Crescent Route.—R. A. Chadwick, Chief Clerk to the General Freight Agent, has been appointed Assistant General Freight Agent of the Alabama Great Southern, with headquarters at Birmingham, Ala.

W. J. Quigg has been appointed Assistant General Freight Agent of the New Orleans & Northeastern, Alabama & Vicksburg, and Vicksburg, Shreveport & Pacific, with headquarters at New Orleans.

Rio Grande & Eagle Pass.—C. G. Jackson, Vice-President and General Freight and Passenger Agent, has resigned.

St. Louis Southwestern of Texas.—J. W. Flanagan, formerly General Agent at Havana, Cuba, of the Southern Pacific, has been appointed General Passenger Agent, with headquarters at Tyler, Tex. Mr. J. F. Lehane, now General Freight and Passenger Agent, will devote his time to the freight department.

San Pedro, Los Angeles & Salt Lake.—W. G. Raef, Assistant General Manager of the Pan-American, has been appointed Assistant General Manager.

Southern Indiana.—F. M. Trissal, General Solicitor of the Southern Indiana and the Illinois Southern, has resigned and is succeeded by Edward C. Ritsher.

Southern Pacific.—B. G. Bartholomew, Acting Freight Auditor, has been appointed Freight Auditor of the Atlantic system, with headquarters at Houston, Tex.

Toledo Railway & Terminal.—The control of this company having passed to the Cincinnati, Hamilton & Dayton, the following new officers are announced: Eugene Zimmerman, Chairman of the Board; Russell Harding, President; T. B. Fogg, Vice-President and General Manager; Thomas J. Walsh, Secretary, and J. E. Howard, Treasurer.

Union Pacific.—See Oregon Short Line.

Wheeling & Lake Erie.—H. B. Henson, Treasurer, has been appointed Secretary and Treasurer, with office in New York City.

Zanesville & Western.—H. Q. Wasson, who has just been appointed Assistant General Freight Agent of the Hocking Valley, has been appointed Assistant General Freight Agent, succeeding C. F. Mayer.

LOCOMOTIVE BUILDING.

The Quebec & Lake St. John has ordered one locomotive from F. M. Hicks & Co.

The Temiskaming & Northern Ontario has ordered three locomotives from F. M. Hicks & Co.

The Imperial Government Railways of Japan have ordered 150 locomotives from the Baldwin Works.

The Philadelphia & Reading will, it is reported, build a number of passenger engines at its Reading shops.

The Seaboard Air Line is reported to have ordered five ten-wheel (4-6-0) passenger locomotives from the Richmond Works of the American Locomotive Co.

The Chicago & Western Indiana has ordered 10 simple six-wheel (0-6-0) switching locomotives from the Baldwin Works for October delivery. These locomotives are to weigh 140,000 lbs. on drivers; cylinders, 20 in. x 26 in.; diameter of drivers, 51 in.; radial stayed boiler, with a working steam pressure of 200 lbs.; 331 National Tube Co.'s tubes, 2 in. in diameter and 11 ft. long; Otis steel firebox, 108 in. x 40 in.; grate area, 339 sq. ft.; tank capacity, 5,000 gallons, and coal capacity, eight tons. The special equipment includes: Westinghouse air-brakes, Otis steel axles, magnesia boiler lagging, National-Hollow brake-beams, American Brake-Shoe & Foundry Co.'s brake-shoes, Gould couplers, Nathan injectors, Ash-

ton safety valves and steam gages, Leach sanding devices, Nathan sight-feed lubricators, Simplex springs and Midvale driving wheel tires.

CAR BUILDING.

The Denver, Enid & Gulf has ordered 10 flat cars from F. M. Hicks & Co.

The Pacific & Idaho Northern has ordered one parlor car from F. M. Hicks & Co.

The Quebec & Lake St. John has ordered one passenger car from F. M. Hicks & Co.

The Duluth, Missabe & Northern has ordered one baggage car from F. M. Hicks & Co.

The Flint River & Northeastern has ordered one combination car from F. M. Hicks & Co.

The Midland Valley has ordered 40 box cars of 60,000 lbs. capacity from F. M. Hicks & Co.

The American Lumber Company, of Albuquerque, N. Mex., has ordered 25 flat cars from F. M. Hicks & Co.

The Evansville & Princeton Traction has ordered three semi-convertible car bodies from the St. Louis Car Co.

The Nashville, Chattanooga & St. Louis is reported to be building 25 beer cars of 60,000 lbs. capacity at its West Nashville shops.

The Japanese Government is reported to have ordered 500 steel freight cars from the Berwick Works of the American Car & Foundry Co.

The Chicago, Burlington & Quincy has ordered 2,000 box cars from the Pullman Co. and 500 refrigerator cars from the American Car & Foundry Co.

The Chicago & North-Western has ordered 1,500 freight cars from the Pullman Co. in addition to the 1,500 reported in our issue of May 26 as ordered from the same builders.

The Des Moines City Railway has ordered 23 double-truck cars from the St. Louis Car Co. for delivery this summer, and is also building 12 double-truck cars at its own shops.

The Atlantic Coast Line has ordered 1,500 ventilated box cars of 60,000 lbs. capacity, 1,000 from the Anniston, Ala., works of the Western Steel Car & Foundry Co., and 500 from the South Atlantic Car & Manufacturing Co., of Waycross, Ga. These cars will all have American Steel Foundries' cast-steel body bolsters.

The Baltimore & Ohio, as reported in our issue of June 2, has ordered 2,000 steel underframe box cars of 80,000 lbs. capacity from the South Baltimore Steel Car & Foundry Co. and the Western Steel Car & Foundry Co. The steel underframes for these cars will be furnished by the Pressed Steel Car Co. instead of by the Standard Steel Car Co., as erroneously reported. The 1,500 composite gondolas ordered from the Standard Steel Car Co. are to be of 100,000 lbs. instead of 10,000 lbs. capacity.

The Missouri Pacific, as reported in our issue of May 26, has ordered 2,000 wooden coal cars of 80,000 lbs. capacity from the Western Steel Car & Foundry Co., 1,000 to be built at the Anniston, Ala., works, and 1,000 at the works at Hegewisch, Ill.; also 1,000 wooden coal cars of 80,000 lbs. capacity and 1,000 box cars of 80,000 lbs. capacity from the Mount Vernon Car Manufacturing Co., and 1,000 box cars of 80,000 lbs. capacity from the American Car & Foundry Co. The coal cars are to measure 36 ft. long, 9 ft. wide and 4 ft. high, inside measurements, and 38 ft. 2 in. long, 9 ft. 5 in. wide and 8 ft. 1¾ in. high, over all. The box cars are to measure 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, inside measurements, and 37 ft. 8 in. long, 9 ft. 7 in. wide and 14 ft. 3½ in. high, over all. The special equipment for all includes: Bettendorf bolsters, I-beam brake-beams, Streeter steel-back brake-shoes, Westinghouse air-brakes, St. Louis Car Co.'s spiral brasses, Tower malleable couplers, Miner draft rigging, Woodman journal boxes, Union Spring & Manufacturing Co.'s springs, and for the box cars, National door fastenings, Jones car doors and Murphy outside metal roofs.

BRIDGE BUILDING.

ALLENTOWN, PA.—The County Commissioners have awarded the contract for the building of the Catasauqua bridge to the York Bridge Co. at $87,590. Other bids were: King Bridge Co., of Cleveland, Ohio, $92,300. Eyre Construction Co., of Philadelphia, $89,950. National Bridge Co., of Syracuse, N. Y., $107,000. Penn Bridge Co., of Beaver Falls, concrete, $89,900; stone masonry piers, $93,260. Groton Bridge Co., of Groton, N. Y., $94,000. York Bridge Co., of York, $87,590. Alleger & Co., of Wilkes-Barre, concrete, $89,000; stone masonry piers, $92,000. Canton Bridge Co., Canton, Ohio, $91,000. W. H. Gulick, of the Old Dominion Bridge Co., of Phœnixville, $111,257. Oswego Bridge Co., of Oswego, N. Y., $94,300. New Jersey Bridge Co., of Manasquan, N. J., $91,000 and $91,500. Belmont Iron Works, of Philadelphia, $89,000. Berlin Construction Co., of New York, $92,700, and Neelson & Buchman Co., of Chambersburg, $92,900. The bridge is to be 1,154 ft. long and will extend from Front and Pine streets across the canal and Lehigh river and the tracks of the Jersey Central, Catasauqua & Fogelsville and the Lehigh Valley railroads and the Crane Iron Works. It will be a viaduct to the canal, then will come a 170-ft. truss span, then two deck spans of 170 ft., then one through span of 150 ft., with an 18-ft. roadway and two 6-ft. sidewalks, to be completed in six months.

ALPHARETTA, GA.—Bids are wanted July 6 by H. S. Seale, Ordinary of Milton County, for building a steel bridge to consist of five spans of a total length of about 950 ft. over the Chattahoochee river for the joint account of Milton and Gwinnett Counties. A. Ewing, of Lawrenceville, will also receive bids.

ANADARKO, OKLA. T.—Three new bridges are to be built over the Washita river near this place.

CHATTANOOGA, TENN.—Local reports state that the Central of Georgia will build steel bridges at this place, at Chickamauga, Big Talapoosa and Little Talapoosa, and two at Rome, Ga.

HARRISBURG, PA.—Bids are wanted June 13 by the Superintendent of Public Grounds and Buildings for building the steel bridge over the Susquehanna river between Berwick and Nescopeck, estimated to cost $200,000.

MANGUM, OKLA. T.—Contract for replacing several large bridges recently carried away by high water in Greer County will probably be let at the July meeting. Floyd McNeill is County Clerk.

MANITOWOC, MICH.—A contract is reported let by the Chicago & North-Western to Greiling Bros., of Green Bay, at $40,000 for building the sub-structure of the steel bridge to be built over the extension of its road. The total cost of the work will be approximately $100,000.

MERIDIAN, MISS.—The railroads entering this place are planning to jointly build an overhead bridge connecting the city proper with the south side.

NORTH PLATTE, NEB.—The Union Pacific is planning to replace the long wooden trestle over the North Platte river at this place with a steel structure.

O'NEILL, NEB.—Bids are wanted June 20 by E. S. Gilmour, County Clerk, for building a bridge over the Niobrara river between the Counties of Holt and Boyd.

PARIS, TENN.—Two large bridges between this place and the Louisville & Nashville station were recently carried away by heavy rains and floods.

READING, PA.—Bids are wanted June 16 for building a concrete steel bridge to replace the Saucony bridge in Maxatawny township.

WAGONER, IND. T.—Petition is being made by residents for new bridges to be built over the Grand and Verdigris rivers at a cost of about $30,000.

Other Structures.

DALLAS, TEX.—The Missouri, Kansas & Texas, it is reported, has plans ready for building new yards, to include a roundhouse, at this place.

MEDICINE HAT, MAN.—The Canadian Pacific is to build a brick and stone passenger station to be two stories high, 32 ft. x 104 ft.

MEMPHIS, TENN.—The Southern, it is said, has plans ready for putting up two large brick warehouses which will have a combined floor space of 32,000 sq. ft.

The Illinois Central has asked bids for putting up a new warehouse to be 100 ft. x 340 ft., three stories high, to cost about $150,000.

PAYETTE, IDAHO.—The Oregon Short Line is to put up a stone station at this place.

PHILADELPHIA, PA.—A contract, it is said, has been given by the Pennsylvania to John Goll & Co., of Philadelphia, for putting up an engine house and repair shops at Gray's Ferry.

READING, PA.—The Philadelphia & Reading, it is reported, has given a contract to the Charles McCaul Co. for building extensions to its machine shops, to consist of a one and a two-story steel and brick structure 192 ft. x 400 ft. on the north end of the present building, which is 750 ft. long. Two 10-ton and one 35-ton electric cranes will be added and two engine drop tables will be built in the machine shop extension, to be electrically operated. A contract has also been let to the same company for making a storage yard at Reading, to include a one-story brick and steel structure 67 ft. wide x 548 ft. long, which will contain a 10-ton electric crane.

SUPERIOR, WIS.—A contract is reported let for building the union passenger station here at about $35,000.

WAGONER, IND. T.—The Missouri, Oklahoma & Gulf will put up a brick station at this place.

WAXAHACHIE, TEX.—Plans have been completed by the Missouri, Kansas & Texas for a new brick passenger station.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATCHISON, TOPEKA & SANTA FE.—It is reported that the extension of this road from Willard, N. Mex., east to Texico, a distance of about 200 miles, at which point connection is to be made with the Pecos line, will be built by the Lantry-Sharpe Contracting Co., of Kansas City, which recently took the contract for building the section of the new line from Belan, N. Mex., to Willard.

A contract is reported let by this company to Corrigan & McDonald, of Pueblo, Colo., for building a new double track tunnel through Raton Hill, near Raton, N. Mex. It will be through solid rock, 144 ft. below the existing tunnel, and will be 5,000 ft. long.

CANADIAN PACIFIC.—An officer is quoted as saying that a special survey has been authorized by this company for its proposed road from Moose Jaw, Saskatchewan, to the elbow of the Saskatchewan river, about 80 miles, and that prospects of the road being built at an early date are good.

CANADA SOUTHERN.—This company and the Michigan Central are organizing two corporations, one under the laws of Canada and one under the laws of Michigan, also a construction company, for the purpose of building the proposed tunnel under the Detroit

river from Windsor, Ont., to Detroit, Mich. There will be two tunnels running parallel under the river about 30 or 35 ft. apart, each about two miles long. The engineering preliminaries are already begun. The cost of the work will be about $7,500,000.

CAROLINA & VIRGINIA.—This company, which has an authorized capital of $2,500,000, has applied in South Carolina for permission to build a railroad from Charleston, S. C., north to Monroe, N. C., a distance of about 175 miles.

CHATHAM, WALLACEBURG & LAKE ERIE (ELECTRIC).—This company is building a new electric road from Chatham, Ont., northwest to Wallaceburg, a distance of about 20 miles, through a rich farming and fruit raising section.

CHICAGO & NORTH-WESTERN.—This company, it is said, will build a cut-off from Tekamah to Dakota City, on the Omaha line, which will shorten the line about 30 miles between Omaha and Sioux City, and will practically parallel the line which the Great Northern proposes to build.

This company has secured the right of way for building a new road from Pulaski, Wis., to Shawane, a distance of 20 miles, through a rich agricultural district.

CHICAGO & RIVER FOREST.—Incorporation has been granted to a company with this name in Illinois to build a railroad from Oak Park, in Cook County, to a point in Dupage County, near Wheaton, about 15 miles. F. W. McLean, G. W. Bryson, W. K. Kenley, E. T. Ross and E. J. Carter, of Chicago, are interested.

CHICAGO, BURLINGTON & QUINCY.—This company is planning to spend about $350,000 for new yards at Galesburg, Ill. The plans call for the building of two yards each having six receiving tracks and six departing tracks, and between these two will be two classification yards each having 21 tracks.

CHICAGO GREAT WESTERN.—Appropriations, it is reported, have been made by this company for its proposed extension from Arispe, Iowa, northwest for a distance of 15 miles to Creston, and the work is to be done during the present summer.

CHICAGO, ROCK ISLAND & PACIFIC.—This company is planning to build about 80 miles of road through the counties of Washington, Clay and Dickinson, Kan., as a part of a connecting link from Fairbury, Neb., south to Enterprise, on the Salina branch, in Dickinson County. This will give a direct connection to Herington.

This company has made plans for extensive betterments, including the ballasting of track and many new bridges in Kansas and the southwest. In Iowa, the main line is to be straightened, grades reduced and curves eliminated.

CINCINNATI, FLEMINGSBURG & SOUTHEASTERN.—Incorporation has been asked for by this company, with a capital of $125,000 in Kentucky, to build a railroad from Johnson, Ky., southeast through Flemingsburg and Poplar Plains to Hillsboro, a distance of 17 miles. The incorporators include: Attilla Cox, S. S. Bush, J. Dudley Winston and others.

DELAWARE & HUDSON.—Plans have been completed by this company for beginning the work of laying a third track from Jermyn, Pa., to Scranton, a distance of about 12 miles.

FLORIDA ROADS.—A syndicate composed of Chicago and St. Louis capitalists has recently bought about 193,000 acres of land in Liberty and Franklin counties, Fla., and will build a railroad from St. Joseph to Apalachicola, a distance of 40 miles, which it is proposed eventually to extend 100 miles to Quincy and finally to Atlanta, Ga. . G. W. Hayne, of Chicago, and R. H. Hemphill, of St. Louis, are said to be interested.

GRAND TRUNK PACIFIC.—According to reports from Montreal, announcement has been made by Minister of Railways Emerson that the Pacific terminus of this road will be at Kaiwan Island, a short distance from Port Simpson.

GREAT NORTHERN.—According to reports, this company will build, on its proposed extension from Kootenay, B. C., to the British Columbia coast, during the present year, 160 miles from Midway, B. C., to Priceton. About 50 miles of the route lies in the State of Washington.

Contracts are reported let by this company for building about 22 miles of road from Oro, Wash., north to the international boundary line.

GREENFIELD & SOUTHEASTERN.—Incorporation has been granted this company in Arkansas with a capital of $50,000 to build a railroad from Greenfield, in Poinsett County, southeast to Marked Tree, a distance of about 20 miles. The directors include: W. H. Howe, of Greenfield; S. E. Howe, of Logansport, Ind., and J. J. Mardic, of Harrisburg.

GROTON & STONINGTON (ELECTRIC).—The line of the Groton & Stonington Street Railway was on May 6 put in operation from Groton to Westerly, 20 miles.

HAMMOND & SOUTHERN.—Incorporation has been granted this company with a capital of $25,000 in Arkansas to build a railroad from Hammond, in Miller County, east to Hervey, on the Red river, a distance of about 10 miles. L. Evers, J. H. McFarland, of Hammond; J. W. Stayton and J. Volkner, of Newport, and others are interested.

JACKSON, YAZOO CITY & MEMPHIS.—Application has been made in the State of Mississippi for a charter by a company with this name to build a railroad from Vicksburg east and north to Memphis, about 230 miles. The proposed line is via Yazoo City, crossing the Sunflower river at a point near Woodburn, in Sunflower County, and paralleling the Yazoo & Mississippi Valley from Jackson to Yazoo City. The incorporators are: I. N. Barnwell, E. S. Crane and others, of Yazoo City.

KANSAS CITY, TULSA & SOUTHWESTERN.—This company, which was incorporated in Oklahoma with a capital of $2,000,000 to build a road from a point in Kansas through Indian and Oklahoma Territories to Wichita Falls, Tex., has filed an amendment to its charter increasing its capital to $5,000,000 for the purpose of building a railroad from Talala, Ind. T., on the St. Louis, Iron Mountain & Southern, northeast to Joplin, Mo. The incorporators include: J. Forsythe, C. V. Lynch, E. C. Reynolds, C. J. Sawyer and others. (See Construction Record.)

KENTUCKY SOUTHERN.—An amendment to the charter of this company has been filed for the purpose of extending its line from a point near Little Rockcastle river, in Laurel County, Ky., along the boundaries of Laurel, Rockcastle and Pulaski Counties over the Cumberland river to Tateville, where connection will be made with the Cincinnati, New Orleans & Texas Pacific, a distance of about 45 miles.

LOUISVILLE & NASHVILLE.—Contracts are about to be let by this company for lowering the grades and straightening curves on its road from Guthrie to Earlington, Ky., a distance of 53 miles. Bids will also soon be asked for improving the roadbed between Madison and Goodlettsville.

The contract which was recently given to Edington, Griffiths & Co., of Knoxville, Tenn., for building 17 miles of road from Saxton to Corbin, Ky., has been sublet to the Moneville Construction Co., of Memphis, Tenn., and work is to be commenced at once.

MIDLAND VALLEY.—An extension of this road will be built by the Cherokee Construction Co., which recently increased its capital for the purpose. The extension runs through the Osage Indian reservation to Arkansas City, Kan. Congress has granted the right of way through the reservation, with the privilege of opening three towns along the route.

MILWAUKEE, PEORIA & ST. LOUIS.—Incorporation has been granted this company in Illinois to build a railroad from Peoria, Ill., north through the counties of Peoria, Tazewell, Woodford, Marshall, Putnam, Bureau, Lee, Ogle and Winnebago to Rockford, 125 miles.

MISSISSIPPI ROADS.—Incorporation will be asked for by a company with an authorized capital of $1,000,000, to build about 20 miles of railroad from the timber lands to the town of Mehan. The line is to be used for logging. C. S. Horton, S. B. Davidge, A. D. Hermance, Carl Herdic and others, of Williamsport, Pa., are interested.

MOBILE & OHIO.—A contract is reported let for building an extension of the Calhoun City branch from a point 10 miles west of Vardaman, Miss., the present terminus, to Calhoun City. Rights of way for two miles have already been secured.

MORGANFIELD & ATLANTA.—An officer writes that this company will build a railroad from Morganfield, Ky., south to Providence, about 28 miles. Surveys are practically completed and rights of way secured for almost the entire route. Contracts are to be let about June 24. T. B. Young is President, and W. W. Olney, Chief Engineer, Morganfield, Ky.

NEW YORK, NEW HAVEN & HARTFORD.—Surveys are being made by this company for the Danbury, Ridgefield & Port Chester extension which it is proposed to build if the surveys prove satisfactory. The proposed line runs from Danbury, Conn., south to Port Chester, N. Y., a distance of about 32 miles. Such a line would reduce the railroad distance between New York and Danbury by about 15 miles.

NORFOLK & CAROLINA COAST.—A company with this name is being formed by a syndicate represented by Rudolph Kleybolte & Co., of New York, and will ask for incorporation in Virginia with a capital of $15,000,000. It is proposed to acquire about 500,000 acres of timber land in eastern North Carolina and build a railroad from Norfolk in a south and westerly direction through Elizabeth City, Edenton and Belhaven, N. C., and through the counties of Beaufort, Pamlico, Craven and Carteret, with branches into Hyde and Tyrrell Counties, the southern terminus being at Beaufort, a distance of about 200 miles. Oakleigh Thorne, of New York, is said to be interested.

NORTHERN PACIFIC.—Surveys are being made by this company for an extension of its Lewiston (Idaho) branch to Grangerville, about 20 miles.

PENNSYLVANIA.—According to Philadelphia reports, an order has been given to complete the low-grade line by the first of next year, which will give the company a new freight road from Gallitzin, Pa., to Glen Loch with the exception of that portion of the main line between Petersburg and Marysville, 97 miles. The new line has been built from Gallitzin to Hollidaysburg, and from that point to Petersburg the Petersburg branch will be used. A new road is being built from Marysville to Glen Loch. The freight line will be double tracked and when this part is in operation it will probably be extended from Glen Loch to Philadelphia. The work on the low-grade line includes the removal of a large amount of rock at Safe Harbor, at which point a viaduct 130 ft. high will be built.

A contract is reported let to the John T. Dyer Co. for making a large yard at West Morrisville, the junction of the Trenton cut-off with the New York division. There will be about 50 miles of track laid.

A contract has been let to H. S. Kerbaugh, Inc., for building a coaling and watering plant at Denholm, on the Middle division west of Mifflin.

The company has begun laying a second main track on the Linden branch, extending from Allen's Tower, Pa., to a point 3½ miles west, just above DuBois. The work will be completed in September.

PORTLAND & SOUTHEASTERN.—A charter has been granted this company in Arkansas to build a railroad from Portland, in Ashley County, Ark., south to the Louisiana line, a distance of about 20 miles. H. C. Brad-

ley, I. Kirk and H. C. Christy, of Cleveland, Ohio; J. C. Bain, of Portland; F. N. Vetter, of Buffalo, N. Y., and others are interested.

ROCHELLE & WESTERN.—A charter has been filed by this company in Louisiana, with a capital of $1,000,000, to build a railroad from Rochelle, La., northwest to Winnfield, a distance of 20 miles; also from Rochelle east to Harrisonburg, a distance of 35 miles. The headquarters of the company will be at Monroe. The incorporators include: C. H. Denkelman, J. C. Simpson, N. S. Cutright, E. T. Lamkin and others.

ROCHESTER, SYRACUSE & EASTERN (ELECTRIC).—This New York company has been authorized to increase its capital stock to $6,000,000. It is building a new double-track electric road from Rochester to Lyons, 37 miles, and plans extensions. L. C. Smith is President, and C. D. Beede, Manager.

ROODHOUSE & VIRDEN.—A charter has been granted this company in Illinois to build a railroad from Roodhouse, Ill., east through Scottville and Modesto to Virden, about 35 miles. The incorporators and first board of directors include: Charles W. Payne, of Roodhouse; James Walker, of Scottville; James A. Fletcher, of Modesto; H. C. Simmons, of Virden, and Bert Vancil, of Springfield, Ill.

ST. LOUIS & SAN FRANCISCO.—Announcement has been made that this company will extend its road 100 miles west from Quanah, Tex., probably to Hale Center, Tex., about half way to Roswell, N. Mex.

ST. MARY, SUWANEE & GULF.—Incorporation has been granted this company in Florida with a capital of $20,000 to build a railroad from a point in Baker County west through Columbia and Hamilton Counties to Live Oak, in Suwanee County, and west through the counties of Suwanee, Lafayette, Taylor, Jefferson and Wakulla, a distance of about 180 miles. The incorporators include: Frederick Drew, T. P. Alston, G. L. Drew and R. N. Ellis, Jr.

SHUBUTA & SOUTHWESTERN.—Incorporation has been granted this company in Mississippi with a capital of $25,000 to build a railroad from Shubuta, Miss., to Eucutta, about 18 miles. F. H. Kaupp is President, and J. H. Griffith, Secretary.

SOUTH ATLANTIC TERMINAL COMPANY.—A charter has been granted this company in North Carolina with a capital of $150,000 to build a railroad from Wilmington, south to Southport, Brunswick County, a distance of about 30 miles. H. A. Dougherty, of New York City; D. W. Bullock, of Wilmington, and others are interested.

SOUTH BEND WESTERN (ELECTRIC).—Incorporation has been asked in Indiana by this company with a capital of $100,000. This is a project of the Indiana Railroad Co., which is controlled by the Kennedy syndicate, of New York, and it is proposed to build an electric road from Laporte, Ind., to South Bend, about 28 miles, and from Newcastle to Michigan City, 16 miles.

SOUTHERN.—This company has recently bought a large plot of ground at Citico, near Chattanooga, Tenn., where new yards and terminals will be built.

TOLEDO & ANN ARBOR (ELECTRIC).—This company, which is building an electric road from Toledo, Ohio, to Ann Arbor, Mich., has secured about 80 per cent. of the necessary rights of way out of the total 48 miles. About 13 miles of the roadbed has been graded, and it is expected to have the rails laid by next November.

RAILROAD CORPORATION NEWS.

BALTIMORE & OHIO.—J. P. Morgan & Co. have given notice that the holders of the certificates of deposit for the first-mortgage 4 per cent. gold bonds of the Pittsburg & Western have the option for 30 days from June 1, 1905, of taking for their deposited bonds either par and interest in cash or Baltimore & Ohio new Pittsburg, Lake Erie & Western System refunding mortgage 4 per cent. gold bonds of 1941 on the basis of an even exchange with cash payment for interest adjustments. At the expiration of the 30 days, all deposited bonds whose owners have not chosen to take the new bonds will be sold to the Baltimore & Ohio at par and interest. Of the total issue of $10,000,000 of these first-mortgage 4 per cent. bonds of 1917 of the Pittsburg & Western, almost 75 per cent. have already been secured and deposited as part security for the new Pittsburg, Lake Erie & Western System mortgage.

CANADA ATLANTIC.—This company has filed a new mortgage guaranteed by the Grand Trunk securing $16,000,000 4 per cent. consolidated first-mortgage sterling bonds.

CHICAGO, INDIANAPOLIS & LOUISVILLE.—A dividend of 1½ per cent. has been declared on the common stock. This compares with 1¼ per cent. declared six months ago, which made a total of 2½ per cent. in 1904. In 1903, 3¾ per cent. was paid, and in 1902, 1 per cent. The semi-annual dividend of 2 per cent. on the preferred stock was also declared.

CHICAGO, ROCK ISLAND & PACIFIC.—The Chicago, Rock Island & Pacific Railway Co. has announced that on June 17 it will pay $1.63 per share to its shareholders, being the remaining pro rata payment due on the loan carried on its balance sheet as the "stockholders' improvement loan" and amounting to $1,222,941. This liability was made up of $750,000 transferred in 1885 and $463,000 transferred in 1886, from income account to the credit of addition and improvement account and a few small balances, all of which the company agreed to repay at the end of 20 years in cash or in capital stock. The payment will go largely to the Chicago, Rock Island & Pacific Railroad Co., which owns most of the stock of the C., R. I. & P. Railway Co.

CINCINNATI, FLEMINGSBURG & SOUTHEASTERN.—The Covington, Flemingsburg & Ashland, a narrow-gage line which runs from Johnson, Ky., on the Louisville & Nashville to Hillsboro, 17 miles, has been sold for $152,500 and reorganized under the name of the Cincinnati, Flemingsburg & Southeastern. See Railroad Construction.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—A dividend of 3 per cent. on the common stock has been declared. The last dividend on the common stock was in September, 1904, and was 2 per cent.

Gross earnings for the month of April were $610,799, an increase of $56,716 over 1904. Net earnings for the same period increased $9,957. For the 10 months ending April 30, gross earnings were $6,093,562, and net earnings $1,425,571, the latter an increase of $117,317 over the corresponding period in 1904.

DELAWARE & HUDSON.—The stockholders have the privilege of subscribing pro rata at par on or before July 25 for the $10,000,000 new 40-year 3½ per cent. gold bonds of the Albany & Susquehanna. These are refunding bonds guaranteed by the Delaware & Hudson and convertible into stock at the rate of one $1,000 bond for five shares of stock. Each stockholder has the right to subscribe for one $1,000 bond for every 41 shares of stock held.

DETROIT, TOLEDO & IRONTON.—This company, the successor at foreclosure sale, of the Detroit Southern, has filed a general lien and divisional first-mortgage for $4,253,000 to the New York Trust Co., trustee, and a consolidated mortgage for $22,500,000 to the Knickerbocker Trust Co., trustee.

ILLINOIS SOUTHERN.—This company, whose line runs from Salem, Ill., southwest to Bismark, Mo., 126 miles, with a branch from Missouri Junction, Ill., to Chester, 11 miles, has filed a certificate of an increase of its capital stock from $2,000,000 to $5,000,000. John W. Walsh, Chicago, Ill., is President.

LAPORTE & MICHIGAN CITY TRACTION.—A company of this name has been organized with a capital stock of $400,000 by the purchasers at foreclosure sale of the electric road between Laporte, Ind., and Michigan City. The stock of the Laporte & Michigan City Traction Co. will be assigned to the Indiana (Electric) Railway Co., which will turn over to the bondholders bonds to the amount of $350,000.

NEW YORK CONNECTING (PENNSYLVANIA).—Governor Higgins, of New York, has signed the two bills extending until Sept. 1, 1906, the time within which the New York Connecting Railroad shall begin building its bridge over the East river at Hell Gate to connect the New York, New Haven & Hartford and the Long Island and Pennsylvania railroads. The time within which the bridge shall be completed is extended for five years from that date.

PENNSYLVANIA.—The April gross earnings of the Pennsylvania Lines East of Pittsburg exceeded those of any previous month in its history, with the exception of July, 1903, falling short of that month by $14,823. The gross earnings of the lines directly operated increased $487,400; expenses, $665,000, and net earnings decreased $177,600 over April, 1904. On the Lines West of Pittsburg and Erie, gross earnings increased $273,900 and net earnings decreased $140,700 for the month. For the four months ending April 30, net earnings increased $909,900 on the lines east directly operated, $75,700 on the Philadelphia, Baltimore & Washington, decreased $141,900 on the Northern Central, increased $54,500 on the West Jersey & Seashore and $391,700 on the lines west.

SEABOARD AIR LINE.—The Seaboard Company, incorporated in 1895 in New Jersey to manufacture and deal in railroad equipment, with a capital of $40,000, has increased its stock to $72,000,000 preparatory to carrying out the modified financial plan of the Seaboard Air Line Railway. The new stock is to consist of $18,000,000 5 per cent. first preferred, $18,000,000 6 per cent. second preferred (non-cumulative) and $36,000,000 common stock. The first preferred is cumulative beginning in 1910 and is convertible into second preferred stock at par. The second preferred is redeemable at 110 after three years from the date of issue, but only in case all the first preferred shall previously have been redeemed or exchanged. It is provided in the amended charter that the shares of the Seaboard Air Line Railway held by the Seaboard Company, shall not be voted for the merger or consolidation of any railroad company other than the Atlanta & Birmingham Air Line or the Seaboard & Roanoke except with the consent of 75 per cent. of the stockholders of the Seaboard Air Line Railway.

SOUTHERN.—Net earnings for the month of April were $786,447, an increase of $105,123 over 1904. For the 10 months ended April 30, gross earnings were $40,465,063, an increase of $2,337,261, and operating expenses and taxes, $29,100,279, an increase of $1,500,624, leaving net earnings of $11,364,784, an increase of $836,636 over 1904. The gross and net earnings for the ten months are the largest for any similar period in the company's history.

TWIN CITY RAPID TRANSIT.—The stockholders have approved the proposed increase of $5,000,000 in the common stock. They have the privilege of subscribing to the new stock to the extent of 5 per cent. of their holdings.

VIRGINIA & TRUCKEE.—The Secretary of this company has issued a call for a meeting of the stockholders for June 24 to arrange for the sale of the road to another corporation, presumably a Southern Pacific Company. The road runs from Reno, Nev., on the Central Pacific to Virginia, 52 miles, and carries most of the ore shipments from the Tonopah and Goldfield districts.